MODEL FOR LAND-USE IN LATE ACHEULIAN TRADITION

(Satna District, M.P.)

PRAKASH SINHA

About the Book

This book deals with a number of precise problems and objectives. Special emphasis is laid on to refine the traditional data collection by adopting the probability sampling procedure, to retrieve information about some aspects of the behaviour of the inhabitants from the data at the unsealed surface sites, to discover the range of variability and relative proportion of the basic subsistence activities, both, at the sites and between the sites and to build model for land-use in late Acheulian tradition in the study area.

The model for land-use presented in this work provided rationale to infer about causes and effects of variability between the sites, primary means of subsistence and settlement pattern. It can be used as a skeleton of similar research in other regions as well.

This book has been presented in seven chapters with three appendies, 30 tables, 95 figures and 36 plates.

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(SATNA DISTRICT, M. P.)

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To J. Desmond Clark

Contents

Foreword

For a long time prehistoric archaeology has meant the study of tool types and their stratification. On this basis chronological scaffoldings have been created for different sites, which on their assumption of a universal typology subject to the role of diffusion have been correlated to provide a general succession of periods illustrating certain familiar hypotheses of social and cultural anthropologists about primitive man. Thus V. G. Childe's work carried forward the torch of Morgon. In our country the interpretation side has been quite subordinate to that of factual tool typology. Late Professor H. D Sankalia's work is the most well known example of this. Late Dr. Birbal Sahni had provided a brilliant example of the analysis of the environmental factors in the fashioning of prehistory. When the Department of Ancient History, Culture & Archaeology, University of Allahabad under the leadership of Late Professor G. R. Sharma took over the lead in the prehistoric archaeology of the Northern Vindhyas and the Middle Ganga valley tool typology and environmental analysis were joined to a new attempt in tracing social changes. Meanwhile, the methods of New Archaeology have been making themselves felt. The author of the present monograph is aware of all these different traditions. He has been trained at Allahabad and London, and has done extensive field work. He critically evaluated the archaeological exploration work done in India, especially in identifying the archaeological sites and collection of artifacts. He has pointed out short comings of uncontrolled exploration and laid emphasis on probability sampling procedure for both, the general survey and site survey and collection of artifacts. He has also made an attempt to retrieve subsistence activities of the late Acheulian man through a statistical model which rests on the interpretations and conclusions drawn from archaeological, ethno-archaeological, microwear and flint-knapping experimental data. He has neatly and systematically presented sample-wise primary data related to alluvial stratigraphy, sites and collection of artifacts. On the basis of primary data he has suggested the depositional history of various geological formations of the Upper tons valley, palaeo-environment of the region and correlated the findings with settlement pattern, subsistence activities and preliminary chronology of the Stone Age cultures of the region. Like the primary data he has also presented the analysis of sites, assemblages, compositions of tool kits and analysis of findings separately, which obviously, would be helpful to others who wish

to re-interpret the data and analysis in their own terms. He has also brought to light various problems usually encountered at the time of comparative assemblage analysis. Under such limitations he has compared the assemblage recovered in the study area with those reported from other parts of the country and suggested a three-fold typo-technological stratification for the Acheulian tradition in India. On the statistical model and the hypothesis proposed by him, he has suggested that in late Acheulian tradition food gathering had an edge on the hunting activity. He has also turned to settlement maping and attempted to reconstruct the model for land-use in prehistoric time (late Acheulian tradition) and tried to explain the rationale behind the variation in the dimension of sites and, why sites of smaller dimension are close to rivers while the larger sites nearer to nalas.

The present work based on his doctoral dissertation is a commendable model for historical and archaeological research. All the data are presented in neat tables, and properly illustrated through figures and plates. All the conclusions are supported by statistical arguments. The analysis of sites, tools, assemblages geo-stratigraphy, palaeoenvironment and potentiality and topographical relationship of the sites have been systematically and logically correlated. More than these he states the importance of controlled sampling and the role of hypothesis in re-discovering the manner in which land was used in the making the old settlements. As is well known, in no science an advance conclusion can be reached without using a testable hypothesis. In the present case the testability is necessarly indirect and partial. Nevertheless it enables one to use the data in new and illuminating ways.

The present work thus not only testifies to the thorough scholarship of the author but itself provides a new model which would be of help to others. I am sure the work would be welcomed alike by students and scholars.

G. C. Pande
Chairman
Allahabad National Museum
Allahabad
(Former Vice-Chancellor
University of Rajasthan &
University of Allahabad)

Date : April 3rd, 1991
Allahabad

Preface

The present work is based largely on my thesis 'Stone Age Cultures of Satna District, Madhya Pradesh' approved in the year 1984 for the D. Phil degree of the University of Allahabad. It is devoted to understanding the land-use in late Acheulian tradition.

Since I was introduced to it, I have been trying to understand Archaeology. At the present state of my knowledge and understanding, it appears to me that archaeology is the study of human behaviour in time and space, primarily based on material culture.

The very first question which has struck me, when I had just begun my career as an archaeologist, was — what is a site ? Is the presence of mearely 3-5 artifacts sufficient enough to classify the place of finding as an archaeological site. To some scholars, however, this has been a sufficient criteria. Another important problem, which has come to my mind during the field expeditions along with my senior collegues and has kept me for a long in puzzle, was—what methodology one should follow in the course of field work, specially for collecting artifacts at the sites. Because I have experienced that the assemblages collected by different individuals even from one single site vary in composition. If one were to rely on the statistics drawn from such collections, ones interpretations and conclusions would be, probably, misleading and confusing. Similarly, a number of problems are yet to be looked into for a systematic, scientific archaeological perspective.

It is hardly possible (at least for me, if not with others) to take up all the problems in one project. I have, therefore, picked up only a few problems to understand them on scientific and justifiable grounds. The problems are commonly related to the regional survey, geomorphology and palaeoenvironment of the region, potentiality of the Stone Age sites and range of variability, behaviour, basic subsistence activities and land-use pattern in late Acheulian tradition in the study area.

I hope that the hypotheses and the models argued and proposed in this work would generate debate and dialogue in sympathetic spirit towards a better understanding about the human behaviour in time and space viz, archaeology.

The criticism that I have made of some researches will, I am sure, be received in an academic spirit. I am glad to note that some of the ideas which I experimented with in the present work (D. Phil thesis) have also found independent collaboration in the works of some of my senior collegues.* I feel emboldened by their support.

Prakash Sinha

Date : April 3rd, 1991
Allahabad.

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* V. N. Misra, 1989, Stone Age India : An Ecological Perspective. *Man & Environment*, Vol. XIV (1) : 19.

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In the completion of the work, I owe my gratitudes to Shri D. Mandal, my supervisor, much more than I can express in words. His very first suggestion "*Jitna tum artifacts se baat karoge utna hi woh jawab denge, woh khud nahi bolte*" has been fruitful to me in the archaeological research.

I am deeply indebted to late Professor G. R. Sharma for his encouragement and inspiration. He was kind enough not only to permit me to study the archaeological material, housed in the Departmental Museum, but also to participate in various archaeological expeditions conducted by the Department of Ancient History, Culture & Archaeology, University of Allahabad.

It is my pleasure and fortune to know Professor G. C. Pande, who is an institution in himself. His scholarly discussions, and critical evaluation of archaeological interpretations and conclusions have always inspired and encouraged me to develop research methodology. I am more than duly grateful to him for taking pains, inspite of illness, for writing a foreword to the present monograph.

I am grateful to Professor J. S. Negi for his suggestions and the deep interest that he has taken in my work. I am thankful to my teachers in the Department, Professor U. N. Roy, Professor S. N. Roy, Shri V. D. Misra and Dr. Om Prakash for their help and encouragement.

I am deeply thankful to Professor D. P. Agrawal, Professor V. N. Misrat Dr. S. P. Gupta, Dr. D. K. Chakraborti, Professor B. D. Chattopadhyaya, Professor R. K. Verma, Professor V. C. Srivastava, Professor P. Singh, Dr. S. N. Rajguru, Dr Vidula Jayaswal, Dr. R. K. Pant, Dr. Sheela Kusumgar, of other institutions for their valuable discussions, suggestions and generous support.

In order to broaden my perspectives and knowledge and for encouragement and guidance, I will remain indebted to Professor J. Desmond Clark, my *guru*, University of California, U. S. A. I sincerely dedicate the presen, monograph to him.

My friends late Shri Mahesh Chandra Misra, Dr. G. K. Rai, Dr. J. N. Pal and Dr. J. M. Kenoyer deserve special thanks for their multifarious help.

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My warm thanks are due to my wife Mrs. Preeti Sinha, who generously shared the burden of reading the proofs besides her domestic engagements.

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I am extremely grateful to my parents who have always been a source of inspiration, encouragement and love.

Prakash Sinha

Dated : April 3rd, 1991
Allahabad

1 Introduction

Since 1863, when Robert Bruce Foote found the first Acheulian artifact, a cleaver, at Pallavaram (Madras) in a lateretic gravel pit, a gradual development took place in the study of the Stone Age archaeology of the Indian subcontinent. However, during the last four decades a relatively systematic regional explorations were carried out by research workers of various institutions. By now, from almost every part of the country the remains of the Stone Age cultures are reported. Besides, some comprehensive regional studies have also been made by a number of scholars of which mention may be made of Sankalia (1974, 1979), Jain (1979), Jaysawal (1978), Misra (1977), Agrawal (1982), etc. The contributions of these studies to the prehistory of India are well known.

The Department of Ancient History, Culture and Archaeology, University of Allahabad, Allahabad has been conducting research in the regional archaeology from about last three decades, primarily in the southern Uttar Pradesh and the northern Madhya Pradesh. With the same research design in view (regional study) a topic entitled "Stone Age Cultures of Satna District, (Madhya Pradesh)" was assigned to the present researcher in the middle of June 1979.

The district of Satna lies between 23° 58′ 10″— 25° 13′ 0″ north parallel and 80° 21′ 20″— 81° 23′ 15″ east meridian. It is bounded by the districts of Banda (Uttar Pradesh) on the north, Rewa on the east, Shahadol on the south and Panna (Madhya Pradesh) on the west and north-west. It measures about 120 km from north to south and about 80 km from east to west covering an area of about 7541 km². The district, from the point of view of administration, is divided into four sub-divisions—Raghurajnagar, Nagod, Maihar and Amarpatan (Fig. 1). Geographically, the district falls into the Vindhyachal—Baghelkhand region (Singh and Singh, 1971 : 622-48).

While taking into account of the work done in the district of Satna prior to that of the present researcher it may be observed that hardly any systematic survey for the study of the Stone Age cultures was carried out in the district excepting the identification of some sites in the sub-division of Maihar. A small area in the sub-division was explored by the Department of Ancient History, Culture and Archaeology, University of Allahabad in the year 1976.[1] The exploration brought to light the existence of only two sites, one each, of the Lower Palaeolithic and the Mesolithic periods (Misra, 1977 : 1-21).

However, the works carried out in the adjoining regions of the district by the workers of the various institutions were indicative of the probable archaeological potentiality of the district with almost similar settings. In this connection mention may be made of the works of Cockburn (1888, 1894), Sharma (IAR[2] 1955-56 : 4, 1973, 1975, 1980 : 93), Wakankar (IAR 1956-57 : 79, 1958-59 : 72), Soundarajan and Joshi (IAR 1957-58 : 25-26), Trivedi (IAR 1957-58 : 67-68, 1958-59 : 27, 1959-60 : 69, 1960-61 : 60, 1962-63 : 68-69), Khatri (IAR 1958-59 : 27), Sen (IAR 1960-61 : 13-17), Ahmed (IAR 1962-63 : 11), Wainright and Malik (IAR 1962-63 : 10-12), Sharma (IAR 1965-66 : 22-23), Sharma and Mandal (1980), Sharma and Misra (1980), etc. Besides, the Stone Age studies in the valleys of the Belan, the Son and the Adwa made by Professor G. R. Sharma and his team offered a sound basis to provide meaningful canvas and direction to conduct archaeological researches in the Vindhyachal-Baghelkhand region.

Basic to the planning of research lies in the precise formulation of the problems and objectives. It is crux of the research planning. The problems associated with the study of the Stone Age cultures in general and those of the Lower Palaeolithic in particular are relatively more complex than the later cultures. Perhaps the most fundamental problem, especially of the Lower Palaeolithic cultures, relates to the state of preservation of sites. Most of the Acheulian sites identified in the sub-continent are in the secondary context. Even the primary context sites are also generally hardly sealed. It is needless to elaborate the shortcomings of the secondary context sites. In the recent decades, however, some sealed sites have been explored and excavated (Joshi, 1966; Wakankar, 1973; Misra, 1975-76; Paddayya, 1977; Misra, et. al., 1979-80, 1982; Gaillard, et. al., 1983). The contributions of these studies are significant. However, in want of holastic approach to the studies it is, perhaps difficult to draw informations for building any dependable model for land-use during the Acheulian tradition. The next vital problem concerns with methods and techniques adopted in the field work. The collection of artifacts at the sites is made generally by uncontrolled method. The adoption of haphazard sampling procedure, needless to emphasize, is bound to lead to nothing but confusion of great consequences. Such sampling methods lack objectivity which is kernel of any scientific study. Equally crucial problem of the study of the early Stone Age cultures relates to the constraints in respect of the availability of the multidisciplinary aids. The facilities of the necessary expertise are hardly available to researchers of the Ph. D. (D. Phil.) level. It is perhaps due to such constraints that the regional survey generally suffers from the dependable information of the palaeoenvironment of the concerned region. The present researcher also could not do justice to the study of the palaeoenvironment of the area in question.

The precise problems and objectives of the present research work are the following :

1. To refine the traditional data collection method by adopting the probability sampling procedure.
2. To identify the alluvial stratigraphy of the Upper Tons valley and to understand the geomorphology of the region.
3. To obtain the representative picture of the inventory of the Stone Age cultures in the district.
4. To find, if possible, undisturbed relevant sites/occurrences in sealed sediments.
5. To identify the probable parameter range and potentiality of the sites in the study area.
6. To retrieve informations about some aspects of the behaviour of the inhabitants from the data at the unsealed surface sites ; and also to discover the range of variability and relative proportion of the basic subsistence activities, both, at the sites and between the sites.
7. To build model for land-use in late Acheulian tradition in the study area.

Due to some unavoidable constraints and limitations it could not be possible to carry proportional investigation, in relation to the problems and objectives as enumerated above, for all the stages of the Stone Age cultures of the area. The data as needed for meaningful statistical study could not be available for all the periods of the Stone Age. A detailed statistical study, therefore, has been made only of the sites and artifacts of the Lower Palaeolithic period.

The work has been presented in seven chapters with three appendies. Chapter-2 is devoted to the methodology and terminology which have been used in this work. The methodology has been divided into two sections i.e. (i) used in the field work and (ii) used in the analysis. The former concerns with the probability sampling procedure that has been applied to the survey and collection of artifacts at the sites. The latter dealing with the analysis has been further divided into two sub-sections. Of these, the first sub-section presents the method which has been used in drawing information about the nature of sites and the attributes of artifacts. The second sub-section concerns with the method that has been applied to the building of hypothesis regarding the variability in the probable basic subsistence activities at the sites and between the sites. It also explains the concept of statistical model as proposed in the work. The section of terminology, obviously, deals with the definitions and concepts of various terms used in the present work.

The available information of the present environment of the district of

Satna has been dealt with in Chapter-3. This chapter is based mostly on the works of different scholars.

The field works comprising survey of the sections on the rivers, tributaries and nalas, identification and study of sites, collection of artifacts, field observations, etc. have been presented in Chapter-4.

In Chapter-5 an attempt has been made to build up the alluvial stratigraphy of the Upper Tons valley.

Chapter-6 deals with the analysis of the various field data regarding the sites identified and the artifact assemblages collected. This chapter has been divided into four sections which provide information about the analysis of sites, the analysis of artifact assemblages, the comparative analysis of the sites and artifact assemblages, and the analysis of findings.

The last Chapter-7 devoted to discussion has been divided into seven sections. Of these, the first six sections comprise discussion on the inter-regional comparison, chronology, subsistence activities at the sites, limitation of morphological analysis, settlement pattern, evaluation of the methodology adopted and the last section presents the conclusion.

Appendix-A presents the statistical formulas which have been used in this work along with the significance of 'sample size'.

Appendix-B deals with the experimental observations made on the flint knapping technique, particularly in relation to the use of different fabricators and rawmaterials.

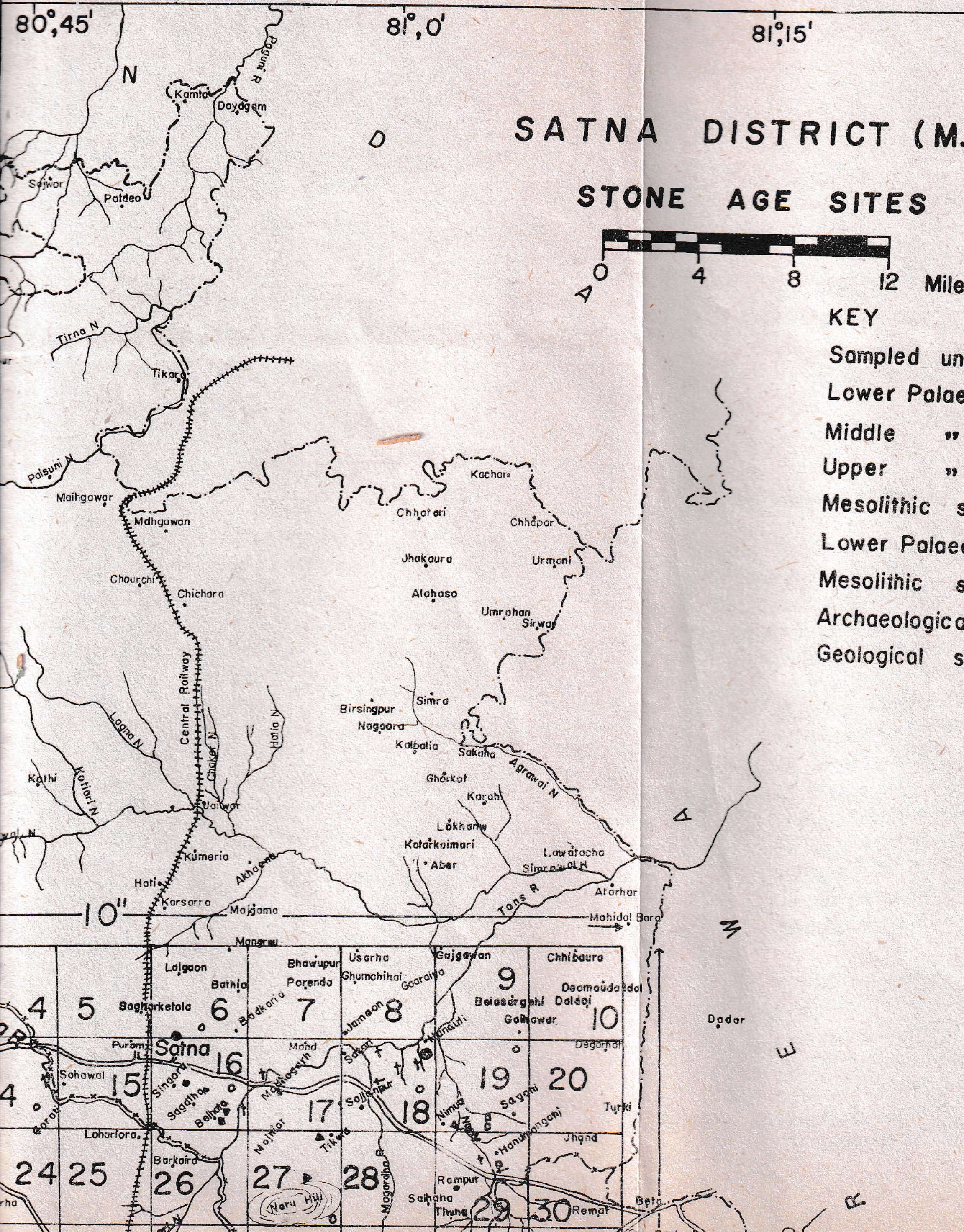
In Appendix-C some suggestions have been made regarding the field work and other problems associated with the archaeological expedition. It also includes an outline of the proposal for future work in the area.

Notes

1. Lately the Department also conducted a preliminary excavation at the Lower Palaeolithic site, as was explored earlier in the Maihar sub-division.
2. IAR—Indian Archaeology-A Review.

LIST OF FIGURE

Figure



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2 Methodology and Terminology

METHODOLOGY

The methodology used in this research may broadly be divided into the following two parts :

A. Methodology used in field work.

B. Methodology used in analysis.

Methodology used in field work

Since the beginning of the discipline, archaeology, archaeologists have been surveying regions for archaeological sites or places to know man's history and his behaviour in remote past. However, the decisions and conclusions of early workers are generally based on fragmentary and disintegrated data of any particular region or site. For complete or nearly complete and integrated data a well thought plan is, perhaps, the most logical way to begin any archaeological investigation in a given or chosen region. A systematic survey would not only provide sufficient data with multi-spectrum information in minimal resources, but also leave behind an adequate record for future investigation. Needless to emphasize that it is mainly a well thought out exploration project and its implementation with systematic and orderly survey that can provide any controlled data for a preliminary characterization of the regional archaeology. Moreover, the information based upon such data also offers a basis for excavation and further exploration and detailed study in the region on scientifically justifiable grounds.

Although, scholars like Kroeber, Spier, Gladwin and Gladwin realised long before 1950's that decisions and conclusions regarding the past history of human behaviour were generally based upon inadequate samples (Kroeber, 1916 ; Spier, 1917; Gladwin and Gladwin, 1928), yet it was only after 1950's particularly under the influence of Vescelius (1960), Spaulding (1960) and others, that archaeologists began to regard the word sampling within the mathematically established technique, generally known as random sampling.

Later, the changing goals and aims in archaeology arising from multi-disciplinary approaches made adherence to a rigorous inductive-deductive method a necessity (Spaulding, 1968 ; Fritz and Plog, 1970 ; Morwood, 1975 ; Salmon, 1976, 1978 ; Schiffer, 1981).

Since 1960's a number of scholars like Binford (1964), Cowgill (1964), Hill (1967), Ragir (1967), Plog (1968), Thomas (1969, 1975), Redman and Watson (1970), Redman (1973, 1974, 1975), Judge (1973), Read (1975), Judge, et. al., (1975), Reid, et. al., (1975) have opined that archaeological explorations would yield the most meaningful results if they are done on a regional basis and if other technique of investigating sites are supported by the procedure of 'probability sampling'. Furthermore, scholars like Binford (1964) and Redman (1973, 1974) suggested that random sampling should be treated as an integral part of comprehensive theoretical and practical research design. The work of Judge (1973) is an excellent example of such an approach.

To achieve its aims and goals archaeology has often borrowed concepts used in other disciplines. Mention may be made of the concept of stratigraphy and uniformitarianism was borrowed from geology. Similarly the concept of sampling is also partly borrowed from statistics and plant ecology. However, the resulting problem has always been the application and modification of these concepts to the special concerns of archaeology. The probability sampling terminology has been discussed by many authors such as Chenhall (1975), Muller (1975), Redman (1974) in detail. It is needless to repeat here, however, the meaning and definition of those terms used in this research work as they are explained in the section on 'terminology'.

Sampling procedure

A bird's eye view on science and social science literatures suggests that there are three general types of sampling procedure, namely, judgment sampling, haphazard sampling and probability sampling.

The sampling based upon the investigator's experience and reasoning is known as judgment sampling. According to Alcock, such type of sampling is more productive than the use of random numbers table in selecting the area to be investigated or the artifacts collected (Alcock, 1951 : 76). However, with the detailed information of cultural material, a researcher could design an effective procedure for sampling but as has been pointed out by Greig-Smith (1964 : 21) that a sample based on judgment sampling cannot provide an unbiased sample of the total material present. Though, depending upon the situation and goal of the researcher, sometimes such sampling procedure is relatively useful, yet it should not be treated as an accurate approximation of total material (Hanson, Hurwitz and Madow, 1953 : 72).

There is sometimes a misconception about the word random used in statistics. Archaeologists sometimes collect data haphazardly and refer to it as an accurate approximation of the total population. Moreover, they call such a sample as a random sample of cultural material at the site, while actually it is a 'grab sample' (Vescelius, 1960 : 459). The fundamental misconception of such sampling procedure, which is a haphazard sampling procedure, is the belief that a random sample is one chosen haphazardly. Actually a random sample follows mathematically defined principles that actually minimise the conscious and unconscious biases and pitfalls of the sampling procedure.

The third sampling procedure which has been recommended by a number of scholars is 'probability sampling'. This procedure is in accordance with the norms established by mathematical theory. In this procedure first of all the universe has to be defined, which in most archaeological studies is the same as the sampled population or target population or isolated field of study. There after, it is divided into sampling units according to the particular probability sampling procedure. Once this is done and the random samples are drawn from the population, the explicit or implicit human biases are minimised. Through this procedure the theoretical limits of reliability may be computed statistically to estimate how close the results extracted from the sampled units are to the parameters of total population (sampled or target population) (Redman, 1974 ; Read, 1975 ; Chenhall, 1975 ; Cowgill, 1975). This procedure also allows one to measure the reliability of qualitative features observed in the material, that is to say to evaluate whether the features are due to sample fluctuation or are result of a cultural process (Redman, 1974). It is now an almost established fact that by following the principle of probability sampling theory, one can draw values close to the values that would have been estimated from investigating the entire population or universe. Binford rightly pointed out that—

> "The days of argument about whether sampling is appropriate in archaeology are over, and those engaged in such discussions are in my opinion fossils of a past era—an era in which archaeologist thought of themselves as knowledgeable experts applying their skills and expertise, totally naive about the responsibilities of the scientist....sampling plays a role, an important role, in his endeavour to increase the accuracy and breadth of our understanding about the past." (Binford, 1975 : 257).

Some scholars argued that even in probability sampling biases are present. In this connection Read has rightly pointed out that—

> "The question that is of more interest to both the archaeologist and the statistician is how to reduce bias, not to demonstrate that it exists. A general answer to this question cannot be given in the abstract, however, for there is no unique answer. For this reason,

the distinction between probability sampling and other kinds of sampling is a false dichotomy—the issue is one of reducing bias, not of using one procedure instead of another. In a given context, a specific probability sampling procedure may be highly biased. That does not argue against probability sampling. It only argues against that particular sampling procedure, in that particular context, for that particular question." (Read, 1975 : 49).

Further some perishable biases have also been pointed out by collins (1975 : 29-31). For such biases Binford's comments are noteworthy—

> "Discussion of all the factors, which may contribute to distortions in the record between the time of observation and the target time in the past of interest to the archaeologist do not affect in any way the desirability of obtaining a representative and unbiased view of the archaeological remains as they in fact exist. Viewed from this perspective most of what Collins has to say is of no interest whatsoever to a discussion of sampling. Perhaps his arguments are more relevant to the question of whether we should even attempt to use archaeological fact in evaluating our ideas about past dynamics or whether it is worthwhile to even do archaeology of any kind." (Binford, 1975 : 253-54).

Probability sampling in archaeological work give several useful kinds of estimates such as probable number of sites in the region or study area, type sites frequency in the region or study area, artifacts density per unit area, probable number of total artifacts at the site, ratio and percentage of class and sub-class of artifact types and frequencies of discrete and metrical attributes of cultural material.

It is true that probability sampling cannot answer every question and equally important, sampling is not easy to implement. It is beyond doubt that it would be better to investigate the entire region or site or collection of total artifacts at site rather than a sample. But as has been pointed out by various authors (Binford, 1975 ; Redman, 1974) for practical as well as financial reasons it is seldom possible and it is for this reason that sampling is most useful. Even if resources (financial) are available to investigate the entire region (universe or population), still there is the serious question as to whether it would be an efficient use of these resources. In this connection Judge, et. al. have rightly suggested—

> "Economy, which is traditionally cited as the primary reason for sampling rather than collection of "all the data", is hardly a realistic justification. It could more logically be argued that a complete inventory of any large population about which little is known can never be taken. One's data thus only partially represent

the population, and a sample derived in a known and controlled manner is far more compatible with the overall scientific paradigm than one taken in a whimsical or unstated way." (Judge, Ebert, Hitchocock, 1975 : 83).

Further Read is also correct in emphasising the importance of probability sampling that—

> "To say that nothing is known about a region, in terms of location of sites, is equivalent to saying a prior that all parts of the region are as likely to contain sites as not. In such a situation, random choice of units to be surveyed will provide the most information." (Read, 1975 : 47).

Redman observes that "sampling is a compromise forced on archaeologists because there are not enough resources for complete coverage. Where the balance is struck in this compromise depends on the data requirements of the researcher and on his general goal." (1974 : 31).

There are many different types of probability sampling designs available to the archaeologist, each with its own advantages and disadvantages. No one of them is best for all situations. However, mention may be made of the following as have been dealt in detail by various authors such as Read (1975), Redman (1974, 1975).

1. Simple random sampling.
2. Stratified random sampling.
3. Systematic, geometric sampling.
4. Systematic, interval sampling.
5. Multiple systematic sampling.
6. Nested or hierarchical sampling.
7. Stratified, systematic, unaligned sampling.
8. Linear, transect sampling.
9. Radial, transect sampling.
10. Systematic, transect sampling.
11. Random, transect sampling.
12. Multiple, systematic, transect sampling.

Each procedure has its advantages and disadvantages according to the situations. The present researcher's aim is restricted to probability sampling

procedures used for gathering data for an areal surface such as the land surface of a region and/or the surface of a site (associated artifacts collection). Therefore, only those procedures have been selected for this research work which are more suitable, convenient, reliable and profitable for the problems and research goals set out in the chapter-1.

The available literature on Indian archaeology hardly referred to the application of probability sampling procedure to the prehistoric survey of a region or excavation of a site.[1] The survey of literature on archaeology in other parts of the world as mentioned above reveals that the method in question applied to this kind of work has been highly rewarding and the discussions and conclusions drawn on this procedure have been more reliable and meaningful than that of judgement or haphazard sampling. Inspite of the fact that the literature on such type of methodology with its merits and demerits has been available since 1960's or so it is somewhat strange that workers in India have not generally been able to take the benefit of this highly effective scientific methodological tool. It may be, perhaps, because archaeological research in India has been basically time oriented.

Although some scholars have collected artifacts at the site through the grid method (Allchin, et. al., 1978; Gaillard, et. al., 1983: 112-30; Misra, et. al., 1983 : 143; Misra, et. al., 1980 : 28; Joshi and Pappu, 1979 : 86-91; Zarine, 1983) still that does not closely represent the probability sampling procedure in the true sense and can better be classified under judgement sampling. It is, ofcourse, certainly true that the collection made by these scholars is slightly better than the collection made without procedure or haphazard sampling.

Of the types (procedures) of probability sampling as mentioned above the following have been applied to this work :

i. Simple random sampling.

ii. Stratified random sampling.

Simple random sampling

It is the simplest kind of orderly selected sample. The process of selection of units from the sampled population and/or target population is done by the use of a random number table, as worked out by various scholars (H. C. Tippett, M. G. Kendall and B. Babington Smith, R. A. Fisher and F. Yates) and also by the random number table generated from the calculator. In this work the random number table has been obtained with the help of TI Programmable—59 calculator (Table 1). The fundamental concept behind the selection of units with the help of random number table is that every sampling unit has an equal probability of being selected. Moreover, this

probability is equal to the ratio of the sample to the total sampled population to be investigated. The sampling frame is considered in an undifferentiated manner; therefore, the probability of being selected is also equal for every combination of units. In practice this involves first of all the counting of the total number of sample units in the sampling frame of the sampled population and then follow the decision about how many units are to be sampled and/or investigated. For this purpose sampling units are numbered serially and the decided number of units are then selected according to the random number table.

Example (*Fig. 2*). In the present example of the hypothetical area (region or site) designated as sampled population, there are 50 sampling units in the sampling frame out of which a sample of 10% i. e. 5 units has been selected from the random number table. In this case the selected random units from the random number table are 4, 10, 12, 25 and 40. These five sampled units will be investigated in detail to infer about the sampled population which comprises 50 units.

This sampling procedure has been applied for the regional survey and for the collection of associated artifacts at the site. In this research, sampled population and target population are the same. Further, the element of interest in the regional or site survey of the sampled population or target population is the sample unit (cf. Chenhall, 1975:5; Read, 1975:52).

Stratified random sampling

The difference between the simple random sampling and stratified random sampling is that in the latter the total area (region or site) is divided into two or more strata depending upon the the situation and an independent random sample is taken from each stratum. Therefore, for the selection of random sampling units from each stratum, the sampling units of each stratum are independently serially numbered. Further, each stratum can be sampled with equal intensity or can be differentially sampled. The differing population can be taken into account when calculating the mean values.

Example (*Fig. 3*). In the present example of the hypothetical area (region or site) designated as sampled population or target population, there are two strata comprising of 30 and 10 units respectively. From each stratum a 10% sample has been selected independently from the random number table. The 10% sample in strata I and II comprises 3 and 1 sampled units respectively. In this case the selected random sampled units in strata I and II are 4, 10, 25 and 3 respectively. These 3 and 1 sampled units will be investigated in detail to infer about the sampled population which comprises 40 units.

The stratified random sampling procedure has been applied particularly for the collection of associated artifacts at sites, which are not flat: sites and

artifacts are found also on the slope of the the site. Here, again sampled population and target population are the same and the element of interest is the sample unit (cf. Chenhall 1975:5; Read 1975:52).

One obvious human bias can occur while surveying the region or site through probability sampling procedure, which can be termed as 'degree of survey'. It means that if one sample unit of the region or a site has been surveyed extensively, and not another then it would provide bias in the sample. Hence, to avoid this bias, all sample units in this work were surveyed with equal degree of care and interest.

Methodology used in analysis

The primary aim of archaeological works has been to know about the systematic context in the light of all the four processes as opined by Schiffer (1972, 1976). It is generally achieved by the analysis of the archaeological context, comparison with the available ethno-archaeological data, experimental archaeological data and inter site and/or inter regional comparison. Further, the result of such comparison and analysis is used to build up a mid-range theory (bridging argument). In the present research, methods adopted in analysis can be divided into two heads—

i. Analysis of archaeological context.

ii. Bridging argument : a model proposed.

Analysis of archaeological context

The sampling ratio of regional survey is calculated by the formula number 1 (Appendix-A). The calculation about the expected frequency range of sites in the sampled population is made through formulas of standard deviation, standard error of sample mean of variable 'y' and parameter mean range (Appendix-A : 2, 3, 4). Here, variable 'y' is the number of sites in each sampled unit.

Artifacts density and expected parameter range of total artifacts at every site are calculated by formulas of artifacts density, standard deviation, standard error of sample mean of variable 'y' and parameter mean range (Appendix-A : 2, 3, 4, 5). Here, variable 'y' is the number of artifacts in each sample unit at the site.

The artifacts analysis of every assemblage is carried out in the following steps—

I. A microscopic study (10X—30X) is made to decide the nature of

every artifact of each assemblage collected at the site i.e. whether sample or assemblage is homogeneous or heterogeneous.

II. Each assemblage is divided into three broad groups for further classification (a) Shaped tools, (b) Modified artifacts, (c) Unmodified wastes.

III. Each group is further divided into tool classes and tool types.

IV. Every artifact of each assemblage is studied for two main attribute groups, (a) Discrete attribute, (b) Metrical attribute.

Discrete attribute

This includes the study of following attributes depending upon type of artifact—(1) Rawmaterial, (2) Physical condition, (3) Completeness, (4) Primary form, (5) Number of flake scars on either face, (6) Retouch nature (7) Retouch class, (8) Retouch invasiveness, (9) Cross-section, (10) Location of retouch or edge damage. (11) Retouched/utilized edge form, (12) Presence of cortex[2], (13) Type of platform, (14) Flake-plan form, (15) Scar pattern on core.

Metrical attribute

This includes the study of following attributes depending upon the type of artifact — (1) Maximum length, (2) Maximum width, (3) Maximum thickness, (4) Width/ Length ratio, (5) Thickness/ Width ratio, (6) Thickness/ Length ratio, (7) Retouched/Utilized length, (8) Flake angle, (9) Edge angle[3] (10) Platform height, (11) Platform width.

Instruments used

Instruments used for the study of discrete and metrical attributes are—simple Vernier calliper, measuring board, modified Vernier calliper, goniometer, eight radial polar grid. For the measurement of length, width, thickness, platform height and width either simple Vernier calliper or measuring board is used and these measurements are in cm. Edge angle is measured by the calliper method proposed by Dibble and Bernard (1980), by modified Vernier calliper. Goniometer is used to measure flake angle. For the exact location of the striking platform and retouched/utilized edge, eight radial polar grid is used (Odell, 1979).

Bridging argument : a model proposed

No parallel ethnographic evidences are available for the Lower Palaeolithic period because of the fact these Lower Palaeolithic men were definitely

not *Homo sapiens.* Now a serious question arises how to build up a mid range theory to know about systematic context of these Lower Palaeolithic sites. However, a very preliminary attempt is being made here for the systematic development and synthesis of bridging arguments on the basis of archaeological data recovered from stratified primary context sites, experimental archaeology, both flint knapping and microwear analysis and available ethnographic data which can be used tentatively for this purpose.

A number of primary context sites have been located in or around the great rift valley of Eastern— Central Africa. These include Kariandusi and Olorgesailic in Kenya and Olduvai Gorge in northern Tanganyika. Olduvai Gorge have focussed the largest known sequences of Pleistocene living sites. Besides, longest sequences, it also suggested a gradual change in the composition of tool kits.

Prior to the excavation at Isimila in southern Tanganyika on the surface three types of assemblages dominated either by large cutting tools, small tools and heavy duty tools were found and archaeologists designated them as two or more cultures. But, after the excavation at Isimila, such type of interpretation became doubtful. Excavation at Isimila revealed that such type of assemblages were present in the same level (Howell,1972: 54). Desmond Clark also noticed that in the contemporary Acheulian floors at kalambo Falls there was a significant difference in the proportion of large cutting tools between two assemblages (Clark, 1964 : 94). Moreover, in late Acheulian at kalambo Falls there are considerably more handaxes than cleavers (Clark, 1964 : 95). Clark also noticed within the same level there was difference among the proportion of large cutting tools, heavy duty tools and small tools among assemblages (Clark, 1964 : 93-101). Kleindienst, also noticed variability within the late Acheulian assemblage in Eastern Africa (Kleindienst, 1961). All these archaeological findings clearly revealed that not only with change in both climate and period, but within the same period there had been change in the composition of tool kit these scholars rightly pointed out that the changes within the same level and time were due to, perhaps, different suits of activities performed by prehistoric man.

In India too, we have evidences of such type of variability among the assemblages in the same region or other. But, it is a pity that no stratigraphic sequences of Lower Palaeolithic or Acheulian traditions are available that can be placed parallel to African and/or European evidences (cf. Misra, 1975-76 : 28-36). Further, most of the Lower Palaeolithic sites in India are in secondary context—riverine sites, therefore it would be better to call them occurrences, though some sites located on the hilly mound or hilly ridges can be placed in the primary context. Beside such type of primary context sites, we have very few reported evidences of well sealed primary context sites (Joshi, 1966 ; Wakankar, 1973 ; Misra, 1975-76 ; Paddayya, 1977 ; Misra, et. al., 1979-80, 1982 ; Gaillard, et. al., 1983). Therefore, while

comparing different assemblages lying open and unsealed require a very careful and detailed analysis because of several reasons (Sinha, n. d. a.).

For Middle Palaeolithic or Mousterian culture Bordes designated five types of assemblages for five different cultures (Bordes, 1961 a, Bordes and Bordes, 1970). There is, however, no distinct stratigraphic evidence for their gradual succession (cf. Laville, 1973). Because of this later evidence and other facts Binford and Binford demonstrated by factor analysis that these assemblages could be called better as different suits of activities rather than cultures (Binford and Binford, 1969 ; cf. Bordes and Sonneville-Bordes, 1970).

Flint knapping experimental archaeologists suggested that flint knapping technique is the combination of two factors, first—method i. e. mind and, second, technique i. e. hand (Crabtree, 1972 : 2). Most of the flint knapping experts suggested that before knapping any tool, its morphological features must be present in mind otherwise one would not be able to make the desired tool type. The opinion of flint knapping experts clearly shows that before flint knapping something is present in mind about the shape of tool and technique to be adopted. Therefore, if one is making a particular tool type it means one wants to use that tool for some particular end. However, we can not say precisely what would have been in prehistoric man's mind, e. g. whether handaxe was made to kill animal or to dig tubers/roots.

Almost similar evidences have been reported in ethnoarchaeological records that to fulfil one particular task tribes look first for the cross-section of stone to be used for that purpose (White, 1967 ; Gould, et. al., 1971). The ethnographic data relating to stone working reported by the aboriginal peoples of Southeast Africa, Asia and Australia has mainly dealt with the use of designed and retouched tools such as scrapers, handaxes and points (Clark, 1958 a, 1958 b ; Gould, et. at., 1971 ; Glover and Ellen, 1975 ; Thomson, 1964 ; Cranstone, 1973). Mention is made of the use of primary flakes by aborigines for butchering animals, cutting hair, scarification and/circumcision in the Andaman Island and Australia, and for wood and bamboo working in New Guinea (White and Thomas, 1972). Archaeological findings also support more or less the above experimental and ethnoarchaeological data, such as at Isimila, the probable use of handaxes was for soft substances like skinning and dismembring thick skin animals (Howell, 1972). Clark and Hayens opined that butchering sites were generally dominated by smallish, rather informal tools including scrapers and denticulates and bifaces specially handaxes are not generally related with the butchering activities. However, their arguments were mainly based upon the findings at Middle Palaeolithic site (Clark and Hayens, 1970). Binford argues that if bifaces are rare it means butchering sites and if, bifaces are common it shows plant gathering (Binford, 1972). However, against the above hypothesis Freeman (1975) and Klein (1978) demonstrated that at butchering sites bifaces (handaxes) are very common.

The microwear analysis carried out by Keeley on Lower Palaeolithic assemblages of Britain suggested that handaxes would have been used for butchering and cutting meat (Keeley, 1980 : 143-46). Besides the above uses, the tip of the handaxe was also used for rotary movement (boring) into the wood (Keeley, 1980 : 101). Moreover, microwear analysis on Lower Palaeolithic assemblage also suggested that Lower Palaeolithic man was also selecting flakes for different activities and selecting those flakes which have had one lateral side natural-backed i.e. with either the cortex present or broad enough for gripping just as in a modern kitchen knife. Similar observations have been made in the course of microwear anylysis of Late Stone Age assemblages of south Sulawesi, Indonesia by the present researcher (Sinha and Glover, 1984). Keeley also proposed a hypothesis that handaxes and cleavers were mainly used for hunting and gathering expeditions, away from the home base. He is also of the view that at butchering sites the number of handaxes should be high if not proportionate (Keeley, 1980 : 160-69). Keeley's arguments are mostly based upon the findings in British Middle Acheulian tradition, where generally handaxes are fonud away from the habitational sites and he wants to restrict his hypothesis particularly for the British Middle Acheulian tradition. Joshi opined that cleavers might have been used for cutting/chopping and the frequency of cleavers will be more in the region having high rainfall and thick vegetation during the late Acheulian tradition (Joshi, 1969-70).

Thus, all the above investigations clearly demonstrate that right from the Lower Palaeolithic period (Middle Acheulian tradition), prehistoric man was manufacturing and selecting artifacts according to his needs. The old concept about the tool uses, e.g. that the handaxe was a multipurpose tool, is now not acceptable on the grounds of available evidences. More or less a similar opinion has been expressed by scholars like Howell (1972 : 49-58). Further, in view of the above mentioned archaeological evidences, ethno-archaeological data, experimental observations, microwear analysis and proposed hypothesis the present researcher more or less agrees with Keeley's hypothesis that handaxes and cleavers both were used for hunting and gathering expeditions. But for hunting handaxes might have been preferred due to their morphological features and most of the microwear analysis suggests butchering/cutting meat activity by handaxes. No doubt handaxes could have been also used for digging tubers, roots, etc. For gathering activities cleavers might have been preferred because of morphological features and their association with the vegetative regions. However, cleavers can be used for cutting meat as well. Microwear analysis for scrapers generally suggests that they were used for scraping wood and hide, and particularly end scrapers were used for hide scraping. Unmodified flakes were used for cutting meat as well as plants. Thus, it seems that handaxes, cleavers and scrapers do suggest some major independent activities. However, scholars group shaped tools into three main categories-large cutting tools, heavy duty tools and small tools. It is based on the preassumption that tool classes grouped together would have been used for the

same purpose, e.g. handaxe, cleaver and knife would have been used for large cutting purpose. But as stated above microwear analysis, flint knapping experiments and ethnographic data show that this is not a correct supposition and requires some modification Therefore, the present researcher thinks that perhaps, atleast for Upper/late Acheulian tradition of Lower Palaeolithic period all main tool classes, not tool types, should be treated as used independently for a particular activity and other tools should be treated as supplementary i.e. as required to complete other supplementary activities. Further, the activity corresponding to the dominating tool class should be treated as the dominating activity at the site and the proportion of that tool class at the base camp/habitational site, should be higher than of other tool classes. The dominant tool class would have been used for the dominant means of subsistence.

Much research work has been done to know about the relationship between archaeological objects and stratigraphy, the utility of backed pieces, selection of rawmaterial, suits of activities performed at different sites during the same cultural period and comparing assemblages. Mention may be made of Hodson (1969), Azoury and Hodson (1973), Whallon, Jr. (1974), Close (1979), Graham (1980), Simek and Leslie (1983), Endo (1983), Akazawa and Hanihara (1983), Berry, et. al. (1983). All these and other studies are based upon the use of different statistical methods such as factor analysis, average link method, double link method, K-means method, parti-chi-square test. Further, the calculation involved in such statistical methods were performed by the use of computers. However, unfortunately, in India archaeologists are not yet getting the benefit of the computer to carry out exhaustive statistical calculation to approve or disapprove hypothesis on scientifically justifiable grounds.[4] This is so, even though, some Indian archaeologists are well trained in computer programming for the archaeological work, like the present researcher. In the absence of computer facilities one must do statistical analysis to prove or disaprove hypothesis, even if not to the extent possible by a computer.

Here, the present researcher is trying to propose a preliminary model for land-use in late Acheulian tradition based on statistical analysis and inferences drawn from the flint-knapping experiments, microwear analysis, ethnographic data and archaeological data as stated above for the systematic development and synthesis of bridging argument to know about the systematic context of the site or region. Further, this model starts with the fact that most of the Lower Palaeolithic site, which can be placed in primary context, are open air unsealed sites (excluding the works at Hunsgi by Paddayya, at Adamgarh by Joshi and Khare, at Bhimbetka III F-24 by Wakankar, at Bhimbetka III F-23 by Misra, and the work of Misra and his colleagues in Rajasthan).

First, we have to decide whether assemblages belong to the same cultural period or not. If to the same, whether they belong to the same tradition or not. To decide this, typological and technological attributes need to be

analysed. If analysis suggests that assemblages belong to similar general period but different traditions they should be treated separately. Further, to confirm our apparent observations regarding types and technique the following statistical analysis may be performed for the assemblages which fall under similar tradition.

Stage-I

The analysis of variance for the attributes of retouch class, retouch nature, invasiveness, presence of cortex, primary form and cross-section of shaped tools may be performed. The concept here is that if they have similar method and technique of flint-knapping there will be no significant difference at 5% level of significance for given degree of freedom (Appendix-A : 6) Moreover, cross-section will also throw light on the similar general activity (White, 1967 ; Gould, et. al., 1971).

Thereafter, if they belong to similar tradition having similar method and technique of flint-knapping, to know whether it was the work of the same group (Band) or different, a propotional Chi-square test at 5% level of significance and for given degree of freedom may be carried out (Apppendix-A : 7). Further, if analysis of variance for the plan forms of flakes show significant difference at 5% level of significance and given degree of freedom, it means that there might be difference in the size and form of primary rawmaterial and or the work of different people.

For open air, unsealed sites an analysis of variance for the attribute abrasion (physical condition) may also be carried out to know the differences in the degree of abrasion among sites. If, at 5% level of significance and given degree of freedom there is no significant difference then it can be inferred that all sites had been facing almost similar type of climatic fluctuations since the prehistoric man left the site.

The metrical attributes, such as length, width, thickness, width/length, thickness/width, thickness/length of main tool classes and flakes may be compared by student's 't' test (Appendix-A:8). If there is a regular significant difference at 5% level of significnace for given degree of freedom, then there is a difference in the size of game and plant material e.g. change in climate or in the technique of hunting and gathering. If the significant difference is not regular, then it shows the work of different people with slight change in climate and technique of hunting and gathering.

The edge angle[3] of tool classes and flake angle of flakes and height and width of platform of flakes can also be compared by student's 't' test method. If there is a significant difference at 5% level of significance for a given degree of freedom, then edge angle would suggest the difference in the activities performed by one similar tool class at different sites and, flake angle and platform attributes would show difference in the technique of percussion.

To confirm typological apparent analysis, an analysis of variance for main tool classes may be performed. If they belong to similar tradition, climate and general need, then there will be no sigificant difference at 5% level of significance for the given degree of freedom.

Stage-II

Upto now, by doing the above analysis we can say whether assemblages belong to similar tradition, climate and general need (activity) of the same cultural period or not, and also whether they are the work of the same group or different group. Now the question arises : if assemblages are of similar traditions, why is there an apparent difference in the proportion of tool class and tool types. To confirm whether such differences are significant or not the following steps may be followed.

Step-I. Proportional analysis of the tool kit of main tool class for Chi-square test. If there is a significant difference at 5% level of significance for given degree of freedom, then there is a difference in the composition of main tool kit because of different suits of activity.

Step-II. Inter-site proportional analysis of individual tool class by Chi-square test. If there is a significant difference at 5% level of significance for given degree of freedom, then tool class which has higher proportion is dominating tool class (activity) of that tool kit of main tool classes.

Step-III. Intra-site proportional analysis of individual tool class by Chi-square test. If there is a significant difference at 5% level of significance for given degree of freedom, then tool class which has higher proportion is dominating tool class (activity) of that tool kit of main tool classes.

Step-IV. Inter-site proportional analysis of individual tool types of each class, if there is a significant difference at 5% level of significance for given degree of freedom, then the tool type which has higher proportion might have been used for some special activity performed at that site.

Step-V. Intra-assemblage proportional analysis of individual tool type of each class, if, there is a significant difference at 5% level of significance for given degree of freedom, then the tool type which has higher proportion might have been used because of its efficiency and/or general preference.

Following the above statistical analysis, we can gather some information about the nature of difference between sites and within sites. Hence we can interpret, discuss and conclude about our findings in the light of arguments developed after such statistical analysis and other observations made at different sites.

The illustrated flow diagrams would be helpful to follow and draw tentative interpretation at each step of stage-II (Fig. 4). However, the final

interpretation and conclusion should be made after considering all other relevant factors observed at different sites and the limitations of such type of statistical work.

Stage-III

To understand and demonstrate the inferences gathered from Stage-I and II, cumulative percentage curves may be drawn for main artifact groups, tool classes and tool types of assemblages. Further to know percentage of dissimilarity among tool kits, as suggested by Stage-II, an average-link coefficient method may be used.[5]

Limitations

1. All assemblage should be approximately equal in respect of total population e.g. the percentage of sample collected at each site should be nearly the same.
2. The presence or absence of floral and faunal evidences must be kept in mind at the time of interpretation and conclusion.
3. The frequency of raw material of all assemblages should be similar.

TERMINOLOGY

Terms used in this research can be grouped under the following heads :

i. Stone Age periods.
ii. Probability sampling.
iii. Analysis.
iv. Typology and lithic technology.

Stone Age periods

To avoid any confusion regarding the terms to define the periods of Stone Age in India, the present researcher follows the decisions taken in the conference on 'Radiocarbon Dating and Indian Archaeology', held at Tata Institute of Fundamental Research, Bombay in the year 1972 (Agrawal and Ghosh, 1973). However, the term Upper Palaeolithic, which has been used for blade-burin industries on parallel model of Upper Palaeolithic in Europe, needs further investigation and discussion because excepting the presence of prismatic blade technology, there is hardly any clear resemblance between the Indian and the European Upper Palaeolithic cultures. A number of tool types have been reported in different traditions of Upper Palaeolithic culture of Europe, which are conspicuous by their absence in Indian Upper Palaeolithic

culture. Moreover, they also differ in view of discrete and metrical attributes, though raw material by this time in both the parts of the world is almost the same e.g. cryptocrystalline. Almost similar doubts have also been raised by Clark and Sharma (1983 : 297).

Probability sampling

Although the terms used in probability sampling have been well defined by a number of scholars such as Redman (1974), Chenhall (1975), Read (1975) and others, but even so the underlying meaning of some of the important terms may be mentioned.

Universe. The term universe refers to an isolated field of study such as a single site or an entire region (Binford, 1964 : 427).

Population. Often the term population is used to represent the total of units being studied, which in most cases is the same as the isolated field of study or universe (Redman, 1974 : 6). The same is the case with the present research.

Sampled population and target population. In this research both sampled population and target population are the same. This is based on the archaeological concept given by Read (1975 : 52) and suggestion made by Chenhall (1975 : 5). Thus in this research sampled population or target population is the total of potential units present in the study area.

Sampling unit. The population is divided into small units for sampling. These units may be 5 m^2 or single archaeological site or 5 km square of land, etc.

Frame. It is a list of all the sampling units that made up the population.

Element. The smallest unit for which information is sought (Kish, 1965 : 67).

Bias. This refer to conscious or unconscious errors of judgment in selection or anything that tends to make the sample consistantly different from the population.

Analysis

Shaped tools. Those specimens which show definite human craftmanship in the modification of flakes, pebble, chunk or nodule etc., for making one particular type of stone tool, have been grouped under this head.

Modified artifacts. In contrast to the shaped tools and unmodified waste, the specimens included in this group show bare modification either by natural agencies or trempling by animals or by use.

Unmodified waste. Under this group are included cores, flakes, chunks etc., which show no sign of retouching or modification.

Discrete attribute. This refers to those variables of artifacts for which it is not possible for an investigator to measure their magnitude.

Metrical attribute. Here, it refers to variables of artifacts which can be measured for their magnitude.

Standard deviation. It is the square root of the airthmetic average of the squares of the deviations measured from the mean (Appendix-A : 2).

Artifact density. Number of artifacts per unit area (Appendix A : 5).

Analysis of variance (F). This is a ratio between two variances e.g. variance between the sample and variance within the sample. The value of F is available at various significant levels for given degree of freedom (Appendix-A : 6).

Chi square $(X)^2$. It is a measure of actual divergence of the observed and expected frequencies. The table values of 'X^2' are available at various significant levels and given degree of freedom (Appendix-A : 7).

Student's 't' test. This is a relationship between the difference of the actual and observed mean and the standard error of the mean. The table values of 't' are available at various probability levels or various significant levels for given degree of freedom (Appendix-A : 8).

Degree of freedom. The term degree of freedom refers to the number of 'independent constraints' in a set of data. The principle of degree of freedom is strictly followed in this research (Appendix-A : 6, 7, 8).

Typology and lithic technology

For the purpose of classification of Lower Palaeolithic artifacts the typology worked out by Kleindienst (1962) has been used, though some types are common in Kleindienst (1962) and Bordes (1961b) classification. Artifacts of the Middle Palaeolithic have been classified on Bordes's typology (1961b). The English translation of Bordes's work (1961b) made by both Misra[6] and Newcomer[7] has been used. For the Upper Palaeolithic and Mesolithic assemblages classificatory terms which are well defined and in currency in the description of Upper Palaeolithic, Late Stone Age and Mesolithic assemblages in India, Africa and Europe and recently used in Sharma and Clark edited volume (1983) have been adopted in this study.

Terms used for the lithic technological features in this work are based mainly on the terms used by Crabtree (1972), Bordes (1961b) and Sinha (1984).

Further, suggestion of Ho-Ho classification and nomenclature committee report (Hayden, 1979 : 133-35), Odell and Odell-Veveaken (1980), Keeley (1980), Tringham, et. al. (1974) have been utilised in classifying edge damage scars or microscars.

Notes

1. Except the work of Possell (1973) in which he demonstrated the use of random sampling and judgment sampling in the course of surface collection of the artifacts.
2. Presence of cortex or old weathered surface has been grouped into four—(1) 100%, (2) 50—100%, (3) 0—50% and (4) 0% groups. For shaped tools and modified artifacts, this includes both dorsal as well as ventral faces and for unmodified wastes this includes only one, dorsal, face.
3. Where more than one edge had been retouched then such artifacts have been counted as two or more (depending upon the number of retouched edges) for the statistical analysis, e g. each handaxe has two lateral retouched edges, so that it has been counted as two for statistical analysis of edge angle.
4. Perhaps, except the computer work done by R. V. Joshi and Maratha 1975-76. Though, it is not to that extent as has been done abroad.
5. For the calculations involved in Stage I, II and III TI-Programmable 59 calculator and Fx-29 Casio calculator were used.
6. Personal communication by Prof. V. N. Misra through typed copy.
7. Personal communication by Dr. M. H. Newcomer, through cyclostyled copy.

LIST OF TABLE AND FIGURES

Table

Figures.

Table 1. Random number Table generated by TI Programmable 59 calculator.

45	03	27	19	06	11	59	57	16	45
14	64	18	33	20	63	79	49	44	56
31	63	66	14	54	24	58	33	14	12
32	61	28	09	04	26	78	38	46	05
61	53	31	64	42	18	62	78	21	07
59	41	17	63	48	27	49	09	78	62
14	56	01	34	07	28	14	39	36	46
36	02	30	68	56	30	23	32	11	25
47	26	75	09	07	58	17	13	77	78
74	22	79	53	73	38	63	09	30	39

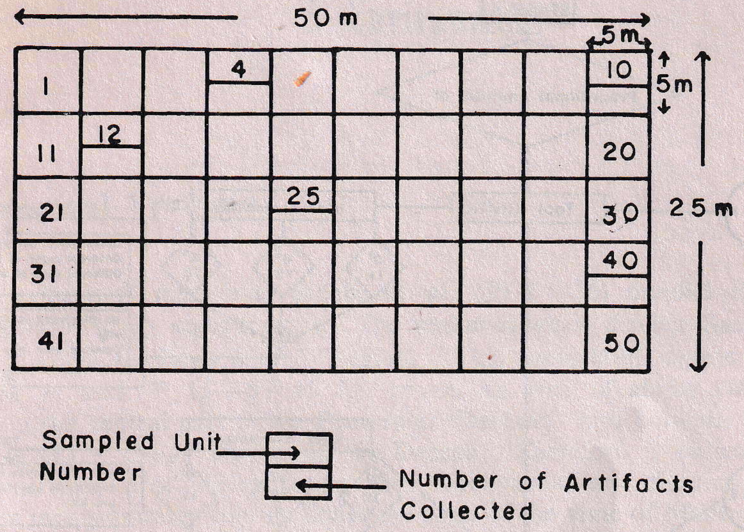

Figure 2. Simple random sampling, hypothetical area : sampled/target population.

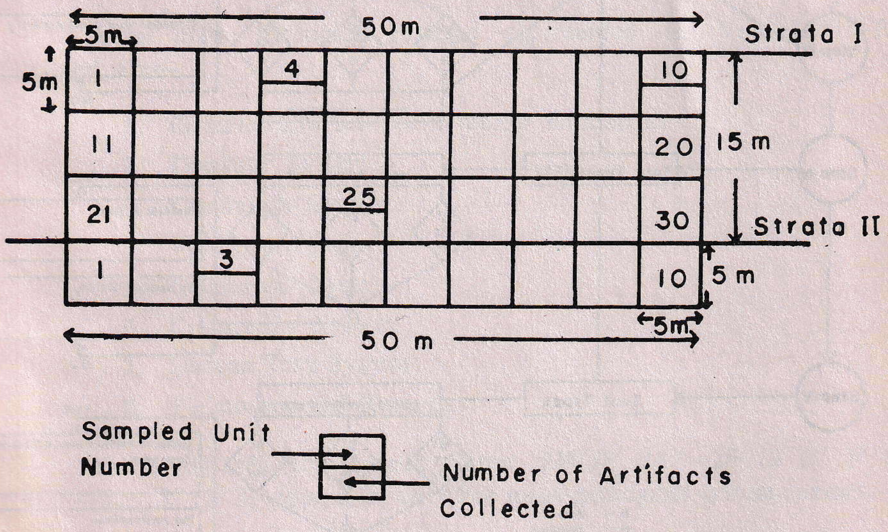

Figure 3. Stratified random sampling, hypothetical area : sampled/target population.

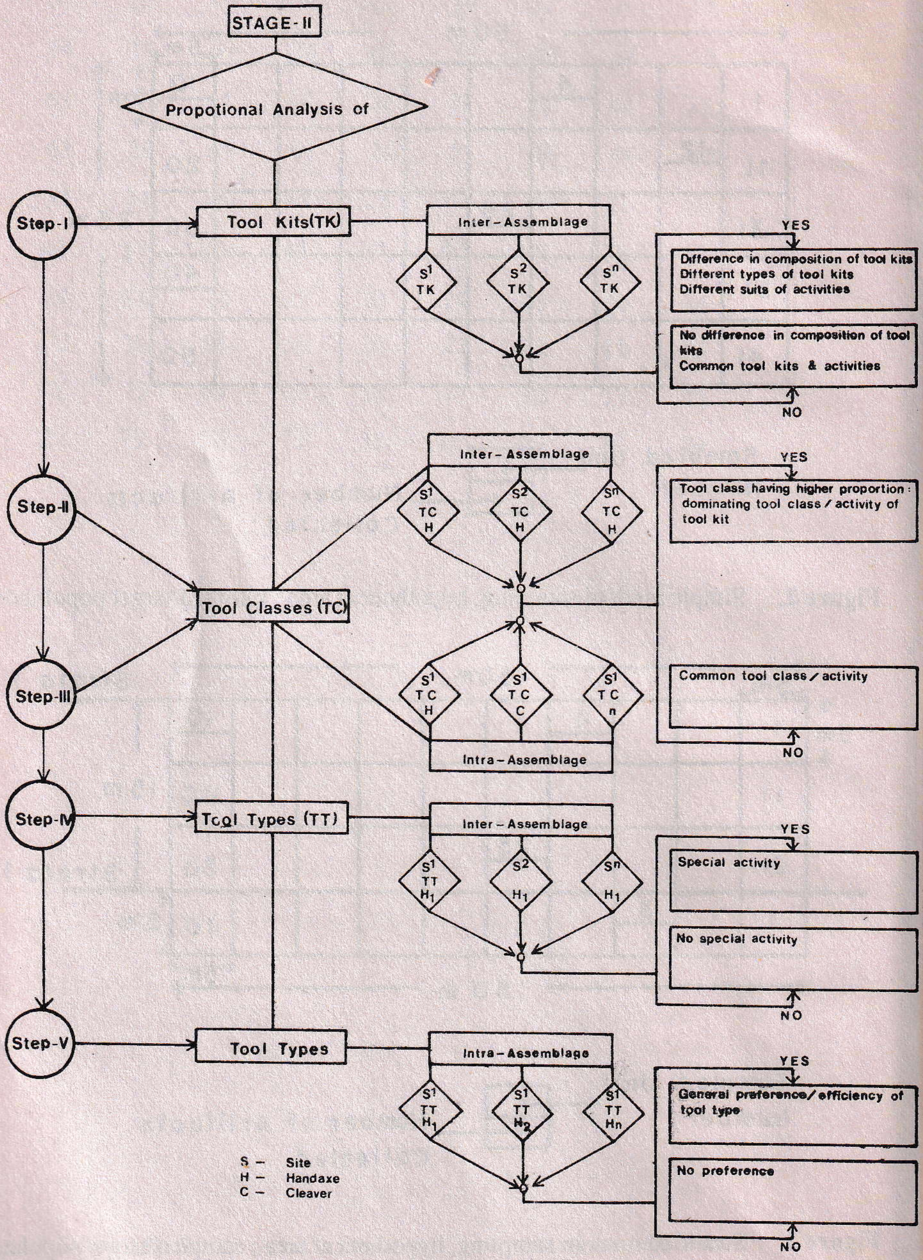

Figure 4. Flow diagrams showing steps of Stage II : model proposed.

3 Environment

Geological Systems

On the basis of meso-level Singh, et. al. (1971 : 36) divided the country, India, into twenty eight regions. The region in which district Satna comes is the Vindhyachal-Baghelkhand Region. This meso-level region (21^0 29'—25^0 11' N and 78^0 15'—84^0 15' E) covers an area of about 140,172 kms.[2] It is in the central part of the Peninsular 'foreland' and between the alluvial stretch of the Great plains and the Deccan. Therefore, it naturally presents a transitional zone incorporating the Vindhyachal and Satpuranchal. The region incorporates within its limits the parts of the state of Madhya Pradesh-Chhindwara, Seoni, Balaghat, Narsinghpur, Jabalpur, Damoh, Pawai sub-division of Panna, Satna, Rewa, Sidhi, Shahdol and Surguja; Uttar Pradesh—Mirzapur and Bihar—southern part of Sasaram and Bhabhua sub-division.

Eight main geological systems represented in Vindhyachal-Baghelkhand are—

1. Granites and Gneiss, including Archaeans
2. Dharwar System
3. Cuddapah System
4. Vindhyan System
5. Gondwana System
6. Cretaceous System
7. Deccan Trap System
8. Pleistocene and Recent.

Our study area, the district Satna, 23^0 58' 10"—25^0 13' 0" N; 80^0 21' 20"—81^0 23' 15" E comprises only five main geological systems namely—

1. Dharwara System
2. Cuddapah System
3. Vindhyan System
4. Gondwana System
5. Pleistocene and Recent

Form No. 4

Dharwara system

The oldest sedimentary strata, which were deposited on the bed of the sea, is known in the geology of India as the Dharwara System. It was formed by the weathering of the pristine Archaean gneisses and schists. (Wadia, 1975 : 89).

In Satna and Rewa the exposures are distinguished by a richly mangeniferous facies, containing large deposit of workable manganese-ores. This system is present in Amarpatan and Maihar administrative sub-divisions of the district Satna.

Cuddapah system

A long interval of time passed b fore the next rock-system began to be deposited. It is on the deeply nacked edges of the Dharwar rocks that the lower strata of the Cuddapah rest (Wadia, 1975 : 113). This system is primarily composed of very hard and compact shales, slates, quartzites and limestones. Quartzites, the most common rocks of the system, are metamorphosed sandstones. This system is present in all the four administrative sub-divisions of district Satna. Besides the above rocks, the Lower Cuddapah contains coloured and banded cherts and jaspers, which is present in the study area.

Vindhyan system

The Vindhyan system was formed under shallow water deposition. "The Vindhyan sandstones throughout their thickness give evidences of shallow water deposition in their often recurring ripple marked and sun-cracked surfaces, and in their conspicuous current-bedding or diagonal lamination characters which point to the shallow agitated water of the coast, near the mouths of the rivers, and the constantly changing velocity and direction of its currents." (Wadia, 1975 : 122). This system has been grouped into the Lower and Upper groups of very unequal proportion. The Lower Vindhyas shows tectonic deformation by folding movements while the Upper Vindhyas are generally lying in undisturbed horizontal strata. This system is present in all the four administrative sub-divisions of district Satna.

Gondwana system

The Gondwana System has been classified into three principal divisions, the Lower, Middle and Upper, corresponding in a general way respectively to the Permian, Triassic and Jurassic of Europe (Wadia, 1975 : 171). Upper Gondwana is present in Amarpatan administrative sub-division of district Satna.

Pleistocene and recent system

Being the briefest of the earth history, the Pleistocene system of geology is in many ways the most fascinating. The geography and topography of most

parts of the world attained their final shape during this period, and floras and faunas to their present distribution. The Pleistocene system in India has a more varied development than the preceding systems, except Archaeans. It covers about 6,50,000 m^2 of North India under river deposits (Wadia, 1975 : 353).

In the study area, down cutting by nalas, rain gullies and erosional activity of a narrow and well defined valley Tons has exposed Pleistocene deposits in different parts of the district. Besides the exposures made by river Tons and nalas, other small rivers, a tributaries of Tons have also exposed different geological deposits ranging from Pleistocene to recent times, almost in every part of the district. This particular system, the Pleistocene is the most important formation from the point of view of man's history and systematic development of his culture and behaviour. Before the present field work, the presence of Pleistocene deposits in the study area has been pointed out by a number of scholars such as Singh and Singh (1971) and Misra (1977 : 3-5). Therefore, with the informations available about these systems (or deposits) the present researcher explored the area as has been explained in the chapter-2. The observations made about the Pleistocene and recent formations, and the alluvial history of the Upper Tons valley and their interpretation will be dealt in detail in chapters-4 and 5, respectively.

Physiography

Main features of physiography in this study area of hill-valley complex are the scarps of the Vindhyan sandstones overlooking the Ganga plain in the north and the Son-trough on the southeast. The tributaries of the Ganga have notched out the northern scarps to make them very irregular and identification extend several kilometer together, but the southern scarps are well like steep and regular, rising sometimes 300 m or above the valley floor (Singh and Singh, 1971 : 622-23).

Between the two scarps is formed, in steps the plateaus of Satna, Rewa and Mirzapur in descending altitudes, respectively. However, the western and eastern fringes are formed by the relatively lower Sonar uplands and higher Rohtas Plateau (Singh and Singh, 1971). The total Upper Vindhyan landscape in accordance with its geolithology is simple. The general horizontality of strata shown no evidence of marked disturbance except minor crumplings in western section and overall tilting to north. The fall and gorges common to the streams descending the plateaus throughout and marking the entrenchings introduced by the territory uplift, clearly demonstrate the horizontal sandstone beds (Singh and Singh, 1971). The ridges, perhaps owe to massive quartzite cappings and mark a large scale hogback structure.

Topography

Topographically, the district Satna covering an area of about 7541 km^2 is divisible into three main units—plains, hilly valleys and, hillocks and forests. These three units comprise approximately 566 km^2, 3985 km^2 and 2990 km^2, respectively.

Like the Belan valley this Tons valley area is also relatively devoid of alluvial land (The District Gazetteer—Allahabad, 1968 : 11). As it is evident from the area covered by later two units, the hilly valleys form a net work in the study area because of a number of small and big nalas and tributaries. The main hilly valleys of the study area are Satna valley, Simrawal valley, Magardha valley and Amaran valley. All these are the tributaries of Tons river. Besides these valleys nalas of the district also make valley formations such as Nat, Bihar, Fadawa, Lilji, Baruani, Karai and Bakoli nalas, etc. The region is full of hills like Naru, Mat, Sirgopahar, Sindoria, Shankar garh, Lalpahar and Kasla, etc.

The main stream of the district Satna is Tons or Tamsa river. The river Tons originated from the Kymore, Katni range in the Murwara sub-division of Jabalpur district. However, now it is a dry bed right from its origin upto Bhadanpur, in Maihar sub-division of Satna district. Its total length from its origin to the confluence of Ganga at Sirsa, Allahabad district, Uttar Pradesh, is approximately 286 km and flow from south-west direction to north-east. Its tributary, Belan river meets at Garkata in Allahabad district. It has been divided into two—Upper Tons valley, which is mainly present in the study area, and Lower Tons valley on the basis of its entrance into relatively low and plain grounds and broadening of the valley. One of its main tributary the river Satna in Nagod sub-division of Satna distrIci is about 57 km long, flow in west-east direction and joins Tons at Barkaira about 7 km south of Satna proper. Other main tributaries and sub-tributaries in four administrative sub-divisions, except Amarpatan where no tributary of Tons is present, are as follows. In Raghurajnagar sub-division tributaries are—Simrawal, flow west to east, about 51 km long, meets Tons at Atarhar ; Magardha, flow south to north, about 15 km long, joins Tons at Bandarkha; and Nat, flow south to north, about 20 km long, meets Tons at Gauraiya. The tributaries and sub-tributaries in Nagod sub-division, besides Satna river which has been mentioned above are Amaran, flow from west t o north, about 8 kmlong, joins Satna river at Katukone; Sukhi, flow south to north, about 15 km long, meets Tons at confluence of Tons and river Satna; Baruaru flow west to east, about 18 km long, joins Tons at Ragla. Lastly in Maihar sub-division tributaries of Tons are Lilji, flow west to north-east, about 8 km long, meets Tons at Basari 2 km south of Echoul; Fadawa, flow west to north-east about 5 km long, joins Tons at Dolnu, 4.5 km south of Echoul; and Seramu, flow east to west, about 11 km long, meets Tons at Eakhwa about 6.5 km south

of Echoul. River Son forms the boundary between Satna and Shahdol district and its tributaries are present in Amarpatan sub-division.

The prevalence of four main seasons of unequal duration has been observed. These durations and their time indicators are-dry summer, pre-Monsoon season, from March to May; wet summer, the Monsoon season, from June to September; transitional period, post-Monsoon season, October and November and winter season, from December to February. These are marked by distinct characteristics of the weather elements. The rainfall in the region is beween 100-120 cm per annum and occurs for the most part during July to September.

Based on Census report 1971, in Satna the average precepitation is 113.71 cm and adjusted precepitation is 140.3 cm. The total water surplus is 26.71, water deficit 53.3 and balance is 26.95 (Cencus of India, 1971, series 1, Part IX : 12). The average temperature in January, April and July is 20°C, 30°C and 30-25°C, respectively (The Gazetteer of India, Vol. I, 1973 : Meterological map II, 72). The wind direction in January, April and July is north-west to east, south-west to north-east and south to east, respectively (The Gazetteer of India, Vol. I, 1973 : Meterological map II, 72).

Six types of forests can be recognised—(i) Dry deciduous teak forest, (ii) Sal forest, (iii) Kardhai forest, (iv) Bamboo forest, (v) Salai forest and (vi) Mixed forest. The dry deciduous teak forest are rather more common in the study area. The chief trees are *dhawa* (*Anogeissus latifolia*), *Sej* (*Lagerstraemia parvifalia*), *haldu* (*Adina cardifolia*), *Saj* (*Tarminalia tomentosa*) *teudu* (*Diospyros melanoxylon*) and bamboo (*Dendrocalamus stricts*). Though bushes of *ber* (*Zizyphus jujuba*) and *Khair* (*Acacia katechu*) are also frequently found.

Wild life of the region is now sparse, but is known to have been plentiful until a few decades ago. Foxes, jackals or *gidars* and wild pigs are ubiquitous in the region. The common antelope locally known as *Hiran* or *Mirag* is often seen moving in the area. Panthers and Leopards are still observed in numbers, i. e., especially in the adjoining forest-clad hilly region.

Keeping in mind the above physiography, topography and environment of the region and the very fact Tons is the main drainage system of the study area, the field work was done according to the methodology set out in the chapter-2. The observations during field work and their interpretations will be dealt in the coming chapters.

4 Field Work

Studies, which are usually carried out in the field rather than in the laboratory or library, are generally known as field work. This is also applicable in the field of archaeology for most of archaeologists are primarily interested in knowing about the places (sites) where people once lived or carried out special activities. To place their findings in chronological order and to know about palaeoenvironment, archaeologists also try to study the geomorphology of the region either with the help of experts like geomorphologists, geoarchaeologists, archaeochemists, etc. This depends upon the scale of the project, the team and the availability of funds. Why do archaeologists or ethnographist or anthropologists etc. carry out field work ? In the case of prehistoric archaeologists, the purpose is generally to know about places (sites) where prehistoric man worked or dwelt and to collect primary data on which may be built up hypothesis about the behaviour and environment of prehistoric people. Field work is also some times done to confirm or disprove hypothesis. Hence, he works on some methodology. In archaeology there are two types of field techniques first-exploration or survey, and second-excavation or digging. Under the first technique archaeologists explore or survey the region for places (sites) and geomorphological features, and try to correlate surface findings in terms of spatial analysis. In the second technique archaeologists excavate or dig the place(s) to know about behaviour, settlement structures and subsistence in terms of different cultural phases or periods of his surface findings. *Thus, exploration or survey is a two dimensional technique, while excavation or digging is a three dimensional technique.*

In this research, the first technique has been followed based upon the methodology as set out in the Chapter-2 and in this chapter field observation will be dealt with.

Strategy

The adoption of strategies for archaeological field work particularly field survey depends upon the consideration of various factors such as the nature of general physiography of the region; the expected potentiality of the area in terms of archaeological material and natural resources; instruments available for survey and the availability of local transport for movement in the regien; goal and methodology to be adopted in the field work to prove or disprove hypothesis; and lastly but not the least the availability of financial support for labour wages, lodging, food and travel.

Problems in carrying field work differ from region to region. For example difficulties in surveying a hilly region-full of forests, hillocks, hilly valleys and plains such as Satna, Rewa, Sidhi districts of Madhya Pradesh would be entirely different from those of plain regions such as Kanpur, Pratapgarh, Lucknow districts of Uttar Pradesh. Therefore, before going to the field it is necessary to know about the present physiography and topography of the region.

Considering the above and other facts in mind a detailed study of regional survey map of Satna district (Survey sheet nos. : 63H, 63D, 64A, 63C) was done to know the area about hillocks, plains, forests and hilly-valleys and, the main drainage systems of the district (Chapter-3). Further, to know the potentiality of the area a thorough study of the adjacent regions like Banda and Mirzapur districts of Uttar Pradesh and Panna, Jabalpnr, Shahadol and Rewa districts of Madhya Pradesh, was done through visits to museums and study of published works such as various numbers of *Indian Archaeology—A Review* and *Prehistory and Protohistory of India and Pakistan* (Sankalia, 1974).

The region of Satna district (7541 km^2) is full of hillocks and forests (approx. 2990 km^2), hilly valleys (approx. 3985 km^2) and plains (approx. 566 km^2). Tons river and its main tributary in the study area, the river Satna are the main drainage systems of the Satna district. Both are respectively about 116 km and 57 km long in the Satna district. Therefore, while deciding the sampled population of the study area it is considered that the maximum portion of Tons and Satna river, representative portion of all the four administrative divisions and a fair representation of all three topographical units such as hillocks and forests, hilly valleys and plains must fall within the sampled population. As has been mentioned earlier (see Chapter-2) in this research the sampled population and target population are the same (cf. Read, 1975 : 52 ; Chenhall, 1975 : 5).

To fulfil the goals of research and apply methodology and its procedures discussed in Chapter-2, the following strategy is applied on the basis of operational preparation and planning. This can be grouped into two :

1. General survey
2. Site survey and collection of artifacts.

General Survey

For the operational planning an area of 10″×8″ was marked on the blue print of the survey sheet (1″=4 mile, survey sheet nos. : 63H, 63D, 64A, 63C) of the district of Satna (Fig. 1). This area (10″×8″) was further divided into smaller sampling units each of 1″ square that produced in all 80 sub-units of which one unit falls outside the district of Satna. It has been excluded from our study as well as from the sampled population. Each square covers an

area of about 40.96 km². Thereafter, each square or quadrat was numbered serially from No. 1 to 79 (Fig. 5). The sampling frame of 79 units covering an area of about 3145 km² forms about 42% of the Satna district.[1] This sampling frame represents the sampled population which is also the target population in this research work. Out of 79 sampling units, 12 units corresponding to the random number table (Table 1) were chosen. These units (12) forming about 15.6% of the sampled population, incluide an area of about 491.5 km² (Fig. 5) These samples are 45, 3, 27, 19, 6, 11, 59, 57, 16, **14**, 64 and 18[2].

It is quite easy to divide an area into units on map, but difficult indeed to make the demarcation in the field. However, in this work railway tracks, roads (melted and mud), rivers, nalas, hills and villages have been used to distinguish various units as marked on the map. They were marked in detail on the blue print of the survey map using 1″=1 mile and 1″=4 mile survey sheets of the region (Survey sheet nos : 63H, 63D, 64A, 63C).

The whole area of selected sample units was surveyed in detail. Each unit was an element of interest, proceeding in the order in which the units were chosen from the sampling frame.

Site survey and collection of artifacts

In course of survey of these sampled units whenever the researcher found any site, the collection of artifacts was made with the assumption (as has been mentioned in the chapter-2) that the size of the site represented the sampled as well as the target population. For this purpose the site (sampled population) was divided into units with a view to apply either the simple or the stratified random sample procedure depending upon topography of the site (as has been set out in the chapter-2). The size of sample units also varied from site to site depending mainly upon the size of the site.

The determination of the size of the site was governed mainly by the nature of artifacts distribution. The area which has heavy concentration of artifacts at one centre but shows a gradual reduction of the concentration from the centre to the periphery, leading, finally to the disappearance of the artifacts represents normally the size of a particular site. However, if just a few artifacts reappeared after a considerable gap, then for obvious reasons these were not considered within the area of the site. Such a situation was considered to be just a case of scatter either by natural agency or animals, or any other agency. Each sampled unit of the sample frame of the sampled population was the element of interest (see chapter-2).

The primary data collected in the field regarding the alluvial history and the sites and artifacts are presented below.

Form No. 5

Primary data : alluvial history

Almost all the sampling units except 6, 27, 57 and 59 have been extremely rewarding in building a preliminary geological frame work for the Upper Tons valley. It will be discussed and interpreted in Chapter-5. Here, we propose to present the details of location and raw-data of each geological section in relation to sampled units (See Fig. 6).

Sample 3 (24° 36′—24° 39′ 40″N; 80°38′—80°42′E)

This quadrat is bounded on north-east, north-west, south-east and south-west by the village Raigaon, river Satna and outer boundary of the village Bandhi, outer boundary of village Mohari, and the village Rairua, respectively. A portion of about 7.5 km of Satna river falls into this sample. No good cliff sections are available. However, about 4 km area observed shows the following types of deposit, which is best represented in the village Rajabar. Thus, Rajabar section reads from bottom to top as follows :

A 2 m thick deposit of yellowish silt of very hard consolidated $CaCO_3$ is resting on weathered rock. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. The second layer is of 1.5 m thick reddish sandy silt resting on undulating surface of previous deposit and comprises of iron, manganese, medium to very coarse sand granules and pebbles. The third deposit is of 1 m blackish sandy silt and consists of small pebbles and a few granules of calcium carbonate which also rests on undulating surface of previous deposit and overlain by a 0.5 m thick humus layer (fig. 7).

Sample 6 (24°36′—24°42′20″N; 80°49′—80°53′E)

This square is bounded on north-east, north-west, south-east and south-west by the village Mangreo, Allahabad-Katni central railway line, the village Badkarva and Allahabad-Katni central railway line, respectively.

Generally, the area covered by this sample is full of hillocks and plains. Mostly the slopes of these hillocks now have been converted into agricultural fields. Most of the rain gulleys, mentioned on the map, at present are cultivated fields. No geological section relevant to our study is available in this sample.

Sample 11 (24°32′20″—24°36′N; 80°30′—80°34′E)

This unit is marked on north-east, north-west, south-east and south-west by the Nagod-Singpur road in the village Sarwakhaira, 1 km north of Nagod-Panna Road, the village Saipur, and the village Kathwari, respectively.

Under this sample besides other villages, Nagod is also present. The cliff-sections are available on both the banks of Amaran river, about 2-3 km south of Nagod in the village Saipur. The cliff sections can be observed for a distance about 1 km. The Saipur section consists of three deposits, which reads from bottom to top as below:

About 1.5—2 m yellowish silt of cemented $CaCO_3$ nodules is lying on the weathered rock. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. This deposit is overlain by 1—1.5 m thick reddish sandy silt which comprises of iron, manganese, medium to very coarse sand granules and pebbles. The third layer is of 1 m blackish sandy silt consists of small pebbles and a few granules of calcium carbonate. There are evidences of erosional (undulating surfaces) break between each deposit. The last deposit is capped by 50-60 cm thick humus layer (Fig. 8).

Sample 14 (24°32′20″—24°36′N; 80°42′—80°46′E)

This quardrat is bounded on the north-east, north-west, south-east, and south-west by confluence of Satna-Nagod road and Satna river, 1.5 km north of Satna-Nagod road in the village Mohari, the village Gorati and the village Jaki, respectively.

Under this sample a portion of about 5 km of river Satna shows at various places cliff sections, which are similar to Rajabar section (sample 3) and Saipur section (sample 11) The best cliff section in this sample is represented in the village Sohawal. This Sohawal section reads from bottom to top as follows:

Adout 3 m thick yellowish silt of cemented $CaCO_3$ nodules is resting on the weathered rock. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. This is capped by a 1.5 m thick reddish sandy silt which comprises of iron, manganese, medium to very coarse sand granules and pebbles. The third deposit—blackish sandy silt is about 1 m thick which consists of small pebbles and a few granules of calcium carbonate. Between each deposit there is an undulating surface which, perhaps suggest erosional activity. The last, third deposit, is overlain by about 0.5 m thick humus layer (Fig. 9).

Sample 16—(24° 32′ 20″—24° 36′ N; 80° 49′—80° 53′ E)

This square is marked on the north-east, north-west, south-east and south-west by the village Badkarra, Allahabad-Katni central railway line, the river Tons, and railway bridge on the river Satna, respectively.

A portion of about 3 km of Tons river was thoroughly examined on both the banks in the village Madhogarh and other small villages. Wherever cliff section is available, it reads the same as found in Madhogarh village. The Madhogarh section from bottom to top reads as below.

About 2 m thick loosely packed graded sediment (gravel) is lying over the eroded and weathered rock and consists of sub-angular to rounded clasts of sandstone, shale, and quartzite ranging from sand size grains to cobble of upto 15 cm diameter, set in matrix of greyish brown clay. Above this deposit a 50 cm thick layer of yellowish silt is found, composed of clasts of sandstone, shale and quartzite. After this there is an undulating surface between this yellow silt deposit and succeeding deposit of 2.5 m thick yellowish silt, consists of hard and well cemented $CaCO_3$ nodules. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. It is overlain by a 4 m thick reddish sandy silt which comprises of iron, manganese, medium to very coarse sand granules and pebbles. The undulating surface of yellowish silt suggest an erosional phase between these two deposits. This reddish sandy silt is capped by another yellowish red silt of 2.5 m thick and comprises of pebbles and a few nodules of calcium carbonate, iron and manganese. Last two deposits are 1 m thick blackish sandy silt which consist of small pebbles and a few granules of calcium carbonate, and finally humus layer—1 m thick (Fig. 10 ; Plate I).

Sample 18—(24° 32′ 20″—24° 36′ N; 80° 57′—81° 1′ E)

The sample unit 18 is marked on north-east, north-west, south-east and south-west by Nat nala in the village Hinouti, the village Jamaon, the village Nimua and the village Tikura, respectively.

This area is drained by river Tons as well as its tributary Magardha river, former is about 5 km and the latter about 5.5 km long in this sampled unit. River Magardha flows from south to north and meets Tons in the village Satari (Banderkha on map), while the Tons flows as usual i. e. from west to east. At a number of places slightly different types of geological deposits are available which can be summarised by three main sections of this sample.

Sajjanpur Section. On the right bank of Magardha river about 0.5 km north of the bridge, made on Satna—Rewa road, the geological deposits from bottom to top read as follows. This type of geological sequence is present for about 1 km on both sides of the river Magardha.

About 30 cm thick small pebbly gravel consists of sub-angular to rounded clasts of sandstone, shale and quartzite ranging from sand size grain to cobble of upto 10 cm diameter, set in matrix of greyish-brown clay. This is overlain by 0.5 m thick yellowish silt composed of clasts of sandstone, shale, and quartzite. The top undulating surface of this yellowish silt shows

erosional activity. This deposit is overlain by a blackish sandy silt of about 50 cm and comprises of small pebbles and few granules of calcium carbonate. The latter is capped by a humus layer of 0.5 m thick (Fig. 11).

Satari Section. On the right bank of river Tons the sequence from bottom to top are 5 m thick yellowish silt of cemented $CaCO_3$ nodules. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. Resting on undulating surface of this deposit is 3 m thick yellowish red silt which comprises of pebbles and a few nodules of calcium carbonate, iron and manganese. This is overlain by 1.5 m thick blackish sandy silt and composed of small pebbles and a few granules of calcium carbonate. This last deposit is capped by 50 cm thick humus layer (Fig 12; Plate II). From the blackish deposit geometrical and non geometrical microliths were also recovered in course of scraping the section. This type of section was observed for about 3 km along the river Tons.

Hinouti Section. On the left bank of nala, locally known as Patpara nala, the sequence from bottom to top are : a loose 2 m thick graded sedimentary gravel rests on the weathered rock and consists of sub-angular to rounded clasts of sandstone, shale, and quartzite ranging from sand size grains to cobble of upto 15 cm diameter, set in matrix of greyish brown clay. It is capped by a yellowish silt of 50 cm thick, composed of clasts of sandstone, shale and quartzite. After an erosional break, as revealed from undulating surface of yellowish silt, 1-1.5 m thick cemented $CaCO_3$ deposit of yellowish silt is present. Besides calcium carbonate nodules, minor concentration of sandstones, shales, quartzites and cherts are also noticed. It is overlain by a 50 cm thick blackish sandy silt after the erosional phase. The latter deposit comprises of small pebbles and a few granules of calcium carbonate. Lastly, it is capped by a humus layer of about 50 cm thick (Fig. 13). This section was examined for about 0 5 km on both the banks of Patpara nala.

Sample 19 (24°32′20″—24°36′N; 81°1′—81°5′E)

This quardrat is bounded on north-east, north-west, south-east and south-west by outer boundary of the village Gathawar, the Nat nala in the village Hinouti, the village Sagoni, and the village Nimua, respectively.

In this sample, about 4 km south of the river Tons in the village Sagoni cliff sections are available on both the sides of Nat nala which meets river Tons in the village Gauraiya. Such type of section can be observed on both the sides of Nat nala for about 2.5-3 km distance. This Sagoni section consists of four deposits, from bottom to top as below.

About 4 m thick yellowish silt deposit of cemented $CaCO_3$ nodules rests on unexposed surface. Besides calcium carbonate nodules minor concentra-

tion of sandstones, shales, quartzites and cherts are also found. It is overlain by 3 m thick reddish sandy silt which comprises of iron, manganese, medium to very coarse sand granules and pebbles. This reddish sandy silt is cappedt by a 3 m thick yellowish red silt which consists of pebbles and a few nodules of calcium carbonate, iron and manganese. Lastly, a 1 m thick blackish sandy silt composed of small pebbles and a few granules of calcium carbonate. It is capped by 50 cm humus layer. Undulating surface between four earlier deposits suggest erosional Phases (Fig. 14; plate III).

Sample 27 (24°28′40″—24°32′20″N; 80°53′—80°57′E)

This square is marked on north-east, north-west, and south-east and south-wes by the village Tikura, the village Majhiar and Naru hill, respectively.

The area present in this sample is full of hillocks, plains and forests. No alluvial cliff section is available in this sample unit. It is due to the fact that neither the tributaries or sub-tributaries of the river Tons nor any other local nala are present in this area. However, hilly rain gullies are present. On these small rain gullies no deposit which can be correlated with the stratigraphy of the Upper Tons valley is noticed.

Sample 45 (24°21′20″—24°25′N; 80°45′—80°49′E)

This quadrat is bounded on north-east, north-west, south-east and south-west by Sukhi nala, unchahara-Nagod road, the village Rampurwa and the river Tons, and Kasla pahar, respectively.

At Unchahara on both the banks of Baruaru nala, cliff sections are available. This type of section is available on both the sides of Allahabad-Katni Central railway line for a distance of about 3 km. A cliff section on the left bank of Baruaru nala (Baruaru section) reads from bottom to top as follows.

At the bottom on the weathered rock rests a 3 m thick reddish sandy silt deposit which comprises of iron, manganese, medium to very coarse sand granules and pebbles. This is overlain by a deposit of 1.5 m yellowish red silt and composed of pebbles and a few nodules of calcium carbonate, iron and manganese. There is an evidence of break, perhaps erosional, which is revealed by an undulating surface between these deposits. Above the second deposit after a considerable gap of time, as suggested by undulating surface, rests another deposit of blackish sandy silt of about 50 cm thick consisting of small pebbles and a few granules of calcium carbonate. This last layer is capped by a 1 m thick humus layer (Fig. 15).

Sample 57 (24°17′40″—24°21′20″ N; 80°53′—80° 57′E)

It is bounded on the north-east, north-west, south-east and south-west by the village Jannohra, the village Ufri, the village Pamwah, and 1 km north of Deccan road in the villaga Chapna, respectively.

Only small rain gullies of Bakaoli nala, a tributary of Tons, are present in this sample. These gullies have no relevant geological section for the study area. The area is full of hillocks, forests and plains. Most of the area has been converted into agricultural field.

Sample 59 (24°17′40″—24°21′20″N; 81°1′—81°5′E)

This quadrat is marked on north-east, north-west, and south-east and south-west by the village Kakora about 1 km north of Bihar nala, about 1.5 km west of Deccan road and forest, and Kaimur hills, respectively.

As in the case of sample 6 and sample 57, here too, the most of the area is nowadays under cultivation. Further, no tributary of Tons or nala is present in this sample.

Sample 64—(24° 14′—24° 17′ 40″ N; 80° 42′—80° 46′ E)

This quadrat is marked on north-east, north-west, south-east and south-west by the nala Lilji and Allahabad-Katni Central railway line, hills, 2.5 km south of Maihar railway station and 1.5 km east of Central railway line, and hills, respectively.

Under this sample two nalas, Lilji and Fadawa show very important geological deposits of the study area. The famous Sharda Temple is covered on all the sides, except on the west by the Lilji nala. The nala Fadawa is on the extreme east-south of the temple. The nala Lilji was observed for a distance of about 3 km, 4 km and 4 km on the north, south and east of the Sharda temple. While the available portion in the sample of Fadawa nala was observed for a distance of about 0.5 km.

Lilji nala meets river Tons at about 2 km south of Echoul, while the nala Fadawa at about 4.5 km south of same place. Both the nalas flow from west to north-east direction and are almost parallel to each other.

The geological deposits observed in the north and east of the Sharda Temple on the Lilji nala show the similar geological sequences, except a variation in the thickness of various deposits. Therefore, the sections observed on the north and south of the temple are mentioned here.

North Lilji Section. It reads from bottom to top as below—

On the weathered rock rests 2.5 m thick loose ungraded boulder gravel which consists of angular and sub-angular to rounded clasts of sandstone, shale and quartzite ranging in size from sand size grains to boulders upto 50 cm in diameter, set in matrix of clay. It is capped by a greyish red/brown clay of 40-50 cm thick, composed of sporadic pebble sized clasts of sandstone, shale and quartzite. After an erosional break, as suggested by undulating surface of grey brown clay comes a 2.5-3.5 m thick yellowish silt with consolidated $CaCO_3$ nodules. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. It is overlain by 3-3.5 m thick reddish sandy silt which comprises of iron, manganese, medium to very coarse sand granules and pebbles. The reddish sandy silt is capped by a humus layer of 50 cm thick (Fig. 16; Plate IV).

South Lilji Section. From bottom to top the deposits are : a loose ungraded boulder gravel, rested on weathered rock and consists of angular and sub-angular to rounded clasts of sandstone, shale and quartzite ranging in size from sand size grains to boulders upto 50 cm in diametre, set in matrix of clay, It is about 1.5 m thick and overlain by 50 cm greyish red deposit composed of sporadic pebble sized clasts of sandstone, shale and quartzite. After an erosional break a loose graded sedimentary gravel of 2.5 m thick is found which consists of sub-angular to rounded clasts of sandstone, shale and quartzite ranging from sand size grains to cobble of upto 15 cm diametre, set in matrix of greyish brown clay. Above this gravel, after an erosional break, a 1 m thick reddish sandy silt deposit is present which comprises of iron, manganese, medium to very coarse sand granules and pebbles. The last deposit is capped by a 40·50 cm thick humus layer (Fig. 17).

Fadawa Section. Section on this nala is similar to the south Lilji nala except variations in the thickness of various deposits. It consists of the following deposits from bottom to top : the lower most deposit resting on the weathered rock is a loose boulder gravel which consists of angular and sub-angular to rounded clasts of sandstone, shale and quartzite ranging in size from sand size grains to boulders upto 50 cm in diametre, set in matrix of clay. It is about 1 m thick and overlain by another loose but graded sedimentary gravel of 2.5 m thick which comprises of sub-angular to rounded clasts of sandstone, shale and quartzite ranging from sandsize grains to cobble of upto 15 cm diametre, set in matrix of greyish-brown clay. There is an undulating surface between these two deposits. Above the second deposit rests a 2 m thick reddish sandy silt and consists of iron, manganese, medium to very coarse sand granules and pebbles. It is capped by a humus layer of 0.5 m thick (Fig. 18).

Findings outside the sampled units

Besides the above observations, at two places which are not under any sampled units important geological sections are present. Though, deposits

present in these sections are not new observations but are rather present in the geological deposits observed within the sampled units, still the picture about two alluvial deposits (formations) of Upper Tons valley became thereby clearer. These two places are Mansva Ghat in the Madhogarh village and the village Rampur. The two deposits of alluvial stratigraphy of Upper Tons valley have been named after these two places. The researcher came across these two sections in course of surveying the sample unit 16 and the sample unit 19, respectively.

Mansva Ghat Section. It is situated on the right bank of river Tons, north of the Madhogarh village. At the bottom on the eroded bed rock rests a 2.5 m thick deposit of loosely packed graded sedimentary gravel, which consists of sub-angular to rounded clasts of sandstone, shale and quartzite ranging from sand size to cobble of upto 15 cm diameter, set in matrix of greyish-brown clay. This is overlain by a 0.5 m thick yellowish silt composed of clasts of sandstone, shale, and quartzite. Above this yellowish silt-deposit rests a 1-2 m thick cemented yellowish silt of $CaCO_3$. Besides calcium carbonate nodules minor concentration of sandstones, shales, quartzites and cherts are also noticed. This cemented yellowish silt is capped by a humus layer of 50 cm thick. There is a break of erosional activity between yellowish silt and cemented deposit. It is because of the fact that the top surface of yellowish silt has a very undulating surface. This section was examined for a distance of about 1 km. Relatively fresh Middle Palaeolithic and rolled Lower Palaeolithic artifacts are found at the bottom of loosely graded gravel (Fig. 19 ; Plate V).

Rampur Section. On the west of the village Rampur, there is a nala on which two deposits are present. These from bottom to top are : at the base on the weathered bed rock rests a 3 m thick yellowish red silt which comprises of pebbles and few nodules of calcium carbonate, iron and manganese. It is overlain by a 2 m thick blackish sandy silt and composed of small pebbles and few granules of calcium carbonate. This blackish sandy silt is capped by a humus layer of 50 cm thick. There is an evidence of erosional activity after the formation of yellowish silt. It is revealed from undulating surface between these deposits. This section was examined for a distance of about 0.5 km. From blackish sandy silt microliths (mesolithic artifacts ?) are found in course of scraping section (Fig. 20).

Primary data : sites and artifacts

At the outset it may be mentioned that in this section only those selected sampled units have been taken into account that provide with archaeological sites. Mention is being made about the probability sampling procedures adopted at each site, site size, size of sample units for the collection of artifacts at each site, percentage of random sample collected, topography and location of sites.

Form No.—6

Sample 11

Survey of this unit brought into light three sites. These sites are Saipur-I, Saipur-II and Saipur-III.

The site, *Saipur-I* (24°33'40"N; 80°50'20" E) is situated about 3 km south of Nagod proper on the right side of Chapa-Nagod road and about 0.5 km west of river Amaran. It is a low relief weathered rock and relatively in the open surroundings. No geological deposit is found at the site. The size of the site is about 10 m x 4 m, and south-north oriented. The distribution of artifacts is even. All artifacts are either fresh or slightly abraded and have no sign of water rolling and have thin patination. This abrasion on the artifacts is, perhaps, because of open air nature of the site. The question of transportation is minimal and the site can be assigned as in primary context. Following the simple random sampling procedure, the site was divided into 2 m x 2 m sample units. Thus, ten sample units were provided and out of them 10% i.e. one random sample unit (sample no. 3) was collected, which consisted of 7 artifacts (Fig. 21). The artifacts are mainly fashioned on quartzite and only a few cobbles and boulders are available in the adjacent area. On the basis of typology and technology it can be assigned to Middle Palaeolithic period.

The site, *Saipur-II* (24°32'25" N; 80°33' E) is situated about 100m south-west of Middle Palaeolithic site, Saipur-I and about 600 m west of Amaran river. It is also on a low relief weathered rock and relatively in open surroundings. No geological deposit is found at the site. The size of the site is about 5 m x 3 m and south-north oriented. The distribution of artifacts is even. Most of the artifacts are patinated, fresh or slightly abraded and have no sign of water rolling. This abrasion on the artifacts is probably because of the open air nature of the site. Considering all these factors and topography of the site it can be said that the site belongs to a primary context. Following the simple random sampling procedure, the site was divided into 1 m × 1 m sample units. Thus, a total of 15 sample units was produced. Out of these sampling units 13% i.e. 2 random sample units, unit no. 1 and 7 were collected, which comprised of 70 and 130 artifacts, respectively (Fig. 22). Thus, a total of 200 artifacts was collected at the site. Mostly artifacts are made on chalcedony, agate, chert and carnalian. There is an absence of source of raw material close to the site. On the basis of typology and technology the site can be classified in Mesolithic period.

The site *Saipur-III* (24°33' N; 80°32'33" E) is situated on the left side of Chapa-Nagod road and is about 2 km south of Nagod. It is about 1.5 km west of Amaran river and 1 km north-west of Saipur. It is lying over the flat yellowish silt containing consolidated $CaCO_3$ deposit and almost in open surroundings. This deposit rests on the weathered rock. The exposed size

of the site is about 10 m x 2 m and west-east oriented. The distribution of artifacts is relatively uneven. Most of the artifacts are patinated and bear no sign of water rolling which suggest that the site is probably in primary context. Following simple random procedure, the site was divided into 1 m x 1 m quadrats, which produced 20 sampling units. Out of these units a 10% i.e. 2 samples (sample 14 and 12) were collected, which consisted of 8 and 13 artifacts, respectively (Fig. 23). Thus, a total of 21 artifacts was collected at the site. Mostly artifacts are made on chert. There is an absence of source of raw material close to the site. Typologically and technologically it can be placed in the late Upper Palaeolithic period, as similar type of artifacts have been placed by other scholars in Indian context.

Sample 16

Four sites were found in this sample. These are Sagatha, Belhata-II, Sinaora and Belhata-I.

The site, *Sagatha* (24° 33′ 40″ N; 80° 51′ E) is situated about 5 km south of Satna proper and 0.5 km north of Satna Aerodrome. It is on a low relief weathered rock and relatively in open surroundings. It is about 4 km and 4 5 km of west of river Tons and north of river Satna, respectively.

The geological sequence exposed at the site by the rain gully shows the following sequence (Fig. 24). At the bottom on the 60 cm thick weathered folded rock rests a 1-1.5 m thick brownish red weathered shale, which is overlain by a small loose pebbly deposit of 40 cm. This pebbly deposit is followed by 60 cm thick yellowish red mixed clay and weathered shale deposit. This last deposit is capped by a thin humus layer of 10 cm. Artifacts are associated with yellowish red deposit. However, this is a local phenomenon of rain gully. The size of the site is about 24 m × 12 m and north-south oriented. The distribution of artifacts is even. Most of the artifacts are in fresh and slightly abraded condition with thin patination though, a few are either moderately or heavily abraded. Topography of the site and physical condition of artifacts suggest that the site probably belongs to primary context. This is also revealed from the condition of artifacts which have no sign of water rolling. Following the simple random sampling procedure, the site was divided into 4 m × 4 m sample units which produced eighteen units. Out of these units about 11.1% i. e. 2 sample units, sample 9 and 14 were collected. These sampled units consisted of 9 and 8 artifacts, respectively (Fig. 25). Thus, a total of 17 artifacts was collected at the site. The artifacts are fashioned on quartzite. There is an absence of source of raw-material close to the site and only a few cobbles/boulders are present. Typologically and technologically it belogs to Lower Palaeolithic period.

The site *Belhata-II* (24°32′30″N; 80°52′E) is situated about 8 km south of Satna proper. It is about 2 km and 4 km west of river Tons and north of river Satna, respectively. Artifacts are lying over the high relief weathered rock and relatively in open surroundings. The geological sequence exposed by rain gully at the site is almost similar to the sequence noticed at Sagatha, except a variation in the thickness of various deposits (Fig 25). The size of the site is about 30 m x 9 m and north-south oriented. The distribution of artifacts is even and have thin patination. Most of the artifacts are in fresh and slightly abraded condition. Though, heavily and moderately abraded artifacts are also present. Yet on the basis of general topography and physical condition of artifacts it can be said that site is in primary context. Following the simple random sampling procedure, the site was divided into 3 m x 3 m units, which produced 30 sampling units. Out of these units about 10% were collected. These 3 sampled units were 1, 7 and 14 which consisted of 7, 8 and 5 artifacts, respectively (Fig. 26). Thus, a total of 20 artifacts was collected at the site. The artifacts are fashioned on quartzite. A few cobbles/boulders are present in the adjacent area of the site. Typologically and technologically the site can be placed into Lower Palaeolithic period.

The site, *Sinaora* (24°32′30″N; 80°33′20″E) is situated about 4.5 km of Satna proper and about 1 km north-west of the site Sagatha. It is on the high relief weathered rock, relatively in open surroundings and about 3 km and 5 km south of river Satna and west of river Tons, respectively. The geological sequence at the site is as follows :

On the weathered rock rests a small pebble deposit of about 25 cm thick over which is a 40 cm yellowish red clay deposit containing a few artifacts. This last deposit is capped by a humus layer of 10 cm thick (Fig. 27). The size of the site is 7 m x 4 m and south-north oriented. The distribution of artifacts is even and thin and, have thin patination. Most of the artifacts are fresh and slightly abraded. The physical condition of artifacts and topography of the site suggest that it is in the primary context. Following the simple random sampling procedure, the site was divided into 1 m x 1 m units, which produced 29 sampling units. Out of which about 10.7% of the sampled population was collected through three random sampled units—9, 4 and 26. No artifact was found in the sampled unit 9, while the other two yielded 7 and 5 artifacts, respectively. Thus, a total of 12 artifacts was collected at the site (Fig. 28). The artifacts are made on quartzite. There is a thin concentration of artifacts and only a few boulders/cobbles are present in the adjacent area. Typologically and technologically this can be assigned to Middle Palaeolithic period.

The site, *Belhata-I* (24°32′31″N; 80°52′E) is situated about 8 km south of Satna proper. The site is present on a high relief weathered rock and relatively in open surroundings. The site is about 100 m east of Belhata-II. It is

about 3.5 km and 2 km south of river Satna and west of river Tons, respectively. The exposed geological sequence close to the site is almost similar to the sequence noticed at Sinaora, except a variation in the thickness of various deposits (Fig. 27). The size of the site is 6 m x 5 m and east-west oriented. The distribution of artifacts at the site is not even and they have a thin patination. Most of the artifacts are in fresh and a slightly abraded condition. The evidence of water rolling on the artifacts is about negligible, therefore, the question of transportation is minimal and the site can be placed in a primary context. Following the simple random sampling procedure the site was divided into 1 m x 1 m sample units, which produced 30 sampling units. Out of which about 10% random sample were collected at the site. These random samples were 11, 25 and 26 which comprised of 9, 0 and 6 artifacts respectively (Fig. 29). A total of 15 artifacts was collected at the site. The artifacts are fashioned on quartzite. A few cobbles/boulders are present close to the site. Typologically and technologically the site can be placed in Middle Palaeolithic period.

Sample 18

Only one alluvial site, Hinouti was found within this sample. A few artifacts were embeded at the bottom of Hinouti nala section (Hinouti section Fig. 13). It is situated about 5.5 km north of Satna-Rewa road and 2 km west of Nat nala. Because of their secondry context nature and as only a few artifacts fashioned on quartzite were present on the exposed lower deposit of Hinouti section, no sampling was done. Artifacts are moderately rolled and can be tentatively placed on the basis of typology in Lower Palaeolithic period. This is a Lower Palaeolithic occurrence rather than a site.

Sample 19

A total of three sites is present in this sample. These sites are Nimua, Sagoni-I and Sagoni-II.

The site, *Nimua* (24° 32′ 30″ N ; 81° 1′ 30″ E) is situated about 2.5 km north of Satna-Rewa road and 0.5 km west of Nat nala. The geological sequence present on the exposed surface reveals that these artifacts are lying on the flat surface of yellowish cemented silt of $CaCO_3$ and almost in open surroundings. This deposit is capped by a humus layer of 20 cm thick (Fig. 30). The artifacts are fresh and most of them heavily patinated suggesting thereby a primary context nature to the site. The distribution of artifacts is not even. The exposed size of the site is 8 m × 2 m and south-west-north-east oriented. Following the simple random sampling procedure it was divided into 1 m × 1 m units, which produced 16 sample units. Out of which about 12.6% i. e. 2 random sample units—7 and 14 were collected. These sampled units consisted of 19 and 13 artifacts, respectively (Fig. 31).

Thus, a total of 32 artifacts was collected. Mostly artifacts are made on chert. There is an absence of source of rawmaterial close to the site. Typologically and technologically this can be assigned to late Upper Palaeolithic period.

The site, *Sagoni-I* (24° 32′ 20″ N ; 81° 3′ E) is situated on the right bank of Nat nala and about 3 5 km north of Satna-Rewa road, in the village Sagoni. It is situated on a low mound, relatively in open surroundings and the exposed area shows the following sequence. At the bottom there is a deposit of about 20 cm thick yellowish red silt containing a few $CaCO_3$ nodules, overlain by a 15 cm blackish sandy silt. This last deposit is capped by a 15 cm layer of humus. It appears that these artifacts are coming out of blackish sandy silt (Fig. 32). The artifacts are fresh and patinated. The distribution of artifacts is not even. Topography and the physical condition of the artifacts suggest the primary context nature of the site. The size of the site is 6 m×3 m and south-west—north-east oriented. Following the simple random sampling procedure it was divided into 1 m×1 m squares, which produced 18 sampling units. Out of these units about 11.1% sample i. e. 2 sample units—17 and 9 were collected. These two sample units consisted of 115 and 39 artifacts, respectively. Thus, a total of 154 artifacts was recovered at the site (Fig. 33). Mostly artifacts are made on chalcedony, agate, chert and carnalian. There is no place close to the site which can be assigned as a source of rawmaterial. Typologically and technologically it belongs to Mesolithic period.

The site, *Sagoni-II* (24° 33′ N ; 81° 3′ E) is situated about 100 m north of Sagoni-I. It is also on a low mound and relatively in open surroundings. The geological sequence noticed at the site reveals almost similar picture as found at Sagoni-I (Fig. 32). The physical condition of the artifacts is fresh and patinated, suggesting thereby primary context nature of the site. It is also south-west—north-east oriented mound site having 4 m×5 m dimension. The distribution of artifacts at the site is even. Following the simple random sampling procedure, it was divided into 1m×1 m sample units, which produced 20 sampling units. Out of these units about 10% sample (2 random sample units—5 and 18) were collected at the site. These units comprised of 60 and 48 artifacts, respectively. A total of 108 artifacts was collected at the site (Fig. 34). Mostly artifacts are fashioned on chalcedony, agate, chert and carnalian. There is an absence of source of rawmaterial close to the site. Typologically and technologically this can be assigned to Mesolithic period.

Sample 27

Two sites were noticed within this sample. These are Tikura and Naru Hill.

The site, *Tikura* (24° 32′ N ; 80° 56′ 20″ E) is situated about 4 km south-east of Madhogarh—Tons bridge and 3.5 km south-west of Sajjanpur—Tons bridge. It is on a high relief weathered rock and relatively in open surroundings. The site is close to the Tikura village, and now a days huts and houses are made on the same height. There is a slight sloping towards south-west. The size of the site is 24 m×12 m and north-south oriented facing river Tons on the west, which is about 6 km from the site. At one place towards the south of the site about at a distance of 60 m a small trench was dug by some labourers, which reveals the following sequence. On the weathered folded rock is present a brownish red shale deposit of 20 cm thick. Over this deposit is a yellowish red clay deposit of 15 cm thickness. This is a capped by a thin humus layer of about 10 cm (Fig. 35). Probably artifacts belong to yellowish red deposit as revealed from the section noticed at Sagatha (Fig. 24). The distribution of artifacts is not even and have a thin patination. Most of the artifacts are fresh and slightly abraded. Topography and physical condition of the objects suggest primary context nature of the site. Following the simple random sampling procedure, the site was divided into 4 m×4 m quadrats which produced 18 sampling units. Out of these about 11.1% sample were collected through two random sample units 11 and 9, which consisted of 11 and 8 artifacts, respectively (Fig. 36) A total of 19 artifacts was recovered at the site. The artifacts are made on quartzite and only a few boulders/cobbles are present close to the site. Typologically and technologically this site can be classified in Lower Palaeolithic period.

The site, *Naru Hill* (24° 31′ 20″ N; 80° 55′ 10″ E) is situated on the foot of Naru Hill and about 6 km south of Madhogarh Tons bridge. The site is not on a high relief weathered rock, rather relatively on a low relief, flat weathered rock. The Naru Hill is present south of the site. It is about 5 km east of river Tons and about at the same distance west of the river Magardha. The geological sequence noticed at the site shows almost similar sequence as noticed at Tikura (Fig. 35). The site has been disturbed unknowingly by civil Engineering Department in course of constructing a road about 2.5 m wide. On the basis of available size of site, therefore, the sampled population or size of the site is 30 m×4 m and 20 m×2 m and south-north oriented (cf Redman, 1974 : 31). The physical condition of most of the artifacts is fresh and slightly abraded, though a few moderate and heavily abraded artifacts are also present. The distribution of artifacts is relatively even and have a thin patination. The topography of the site and physical condition of artifacts suggest primary context nature to the site. The artifacts are fashioned on quartzite and the rawmaterial in the form of boulders/cobbles is available close to the site.

As the situation needed, the stratified random sampling procedure was used, and the site was divided into two strata—I and II on the right and left side of the road approaching hill, respectively. The available size on the right side is 30 m×4 m (Stratum—I) and on the left 20 m×2 m

(stratum—II). These strata were further divided into 2 m × 2 m units which produced 30 and 10 sampling units, respectively. Out of each stratum an independent random number for 10% sample was selected. These random sample units were 5, 18 and 21 in the stratum—I and sample unit 3 was in the stratum—II (Fig. 37). Sampled units of stratum—I consisted of 11, 10 and 8 artifacts, respectively while sample unit 3 of stratum—II contained 10 artifacts. Thus, a total of 39 artifacts was collected at the site. Typologically and technologically this can be placed in Lower Palaeolithic period.

Sample 45

Only one occurrence rather than a site was found in this sample. It is situated on the slope of Kasla hill (Pahar) near the village Mohari about 2 km south of Unchahara. A few artifacts were present and their distribution was scattered. Therefore, no sample was collected at this occurrence. Though, typologically and technically artifacts can be assigned to Lower Palaeolithic period.

Sample 64

A total of six sites and one occurrence was noticed in the sample. These sites and occurrence are Sharda Temple—I, Sharda Temple—II, Sharda Temple—III, Sharda Temple—IV, Sharda Temple—I a, Rampur—I and Rampur—II (occurrence), respectively.

The site, *Sharda Temple—I* (24° 15′ 30″ N ; 80 43′ E) is situated about 800 m south of Maihar-Sharda Temple road and on the left bank of south branch of Lilji nala. The site is lying over the high relief weathered rock and close to the Lilji nala, which is now a dry bed and only during the rainy season (Monsoon period) water flows in this branch. This weathered rock is gradually sloping towards west and on its north-west side a chain of hills is present (Plate VI). No geological sequence was available at the site. The size of the site is 32 m × 24 m and east-west oriented. The distribution of artifacts is not even and have a thin patination. The artifacts are generally slightly abraded but no sign of water rolling which suggest minimal transportation. Therefore, the site can be placed into primary context. Following the simple random sampling procedure, the site was divided into 4 m × 4 m quadrats, which produced 48 sampling units. Out of which 5 random sample units i. e. about 10.4% were collected. These sampled units were 24, 33, 14, 12 and 28 which consisted of 11, 9, 12, 10 and 10 artifacts, respectively. Thus, a total of 52 artifacts was collected at the site (Fig. 38). The artifacts are made on quartzite. The rawmaterial in the form of boulders/cobbles is available close to the site. Typologically and technologically the site can be placed in Lower Palaeolithic period.

The site, *Sharda Temple—II* (24° 15′ 32″ N ; 80° 43′ E) is about 500 m south of Maihar-Sharda Temple road. This is also on a high relief weathered rock and a chain of hills is present on the north-west of the site. Luckily, close to the site a 2 m×3 m trench was dug by civil department which suggested following geological sequence at the site. At the bottom on folded rock rests a moderately weathered rock of about 3 m thick. This is overlain by a 40 cm greyish-red weathered rock. Lying over this is a 10 cm thick deposit of reddish yellow silt mixed with shale fragments. A few artifacts are found embeded into this deposit, which is capped by a 10 cm deposit of humus (Fig. 39). Mostly artifacts are fresh and slightly weathered and show no sign of transportation. The distribution of artifacts is even and have thin patination. The site can be placed into primary context. The size of the site is about 40 m×24 m and east-west oriented. A good number of artifacts were lying on the southern slope of the site, therefore, stratified random sampling procedure was followed. The site was divided into two strata—stratum-I and stratum-II and each into 4 m×4 m sampling units, which produced 60 sampling units Out of each stratum an independent 10% sample was collected. The sampled units of stratum-I and stratum-II were 45, 3, 27, 19, 6 and 3, respectively (Fig. 40). These sampled units consisted of 9, 9, 14, 11, 9 and 10 artifacts, respectively. Thus, a total of 62 artifacts was collected at the site. The artifacts are fashioned on quartzite and the rawmaterial in the form of boulders and cobbles is available close to the site. Typologically and technologically it belongs to Lower Palaeolithic period.

The site, *Sharda Temple-III* (24° 15′ 34″ N ; 80° 43′ 1″ E) is situated about 70 m south of Maihar-Sharda Temple road and about 500 m east of the foot of Sharda Temple hill. It is relatively on a low relief weathered rock and a chain of hills is present on its north-west side. Exposed edges of the mound show almost similar geological sequences as noticed at Sharda Temple II (Fig. 39). The size of the site is 32 m×24 m and east-west oriented and distribution of artifacts is even and have a thin patination. The physical condition of artifacts is generally fresh and slightly abraded, which suggest minimal transportation. Therefore, on the basis of topography and physical condition this site can also be placed as primary context site. Because a good number of artifacts were lying on the eastern slope of the site, the stratified random sampling procedure was used to collect artifacts at the site. For this procedure, the site was divided into two strata—stratum-I and stratum-II and each into 4 m×4 m sampling units. Thus, a total of 48 sampling units was produced. Thereafter, an independent random number for sampling units was selected. These units in Strata-I and II were 9, 4, 26, 38 and 5, respectively (Fig. 41). These sample units consisted of 10, 13, 11, 11 and 10 artifacts, respectively. Thus, about 10.4% sample was collected at the site. The total number of artifacts collected at the site was 55. The artifacts are made on quartzite. The rawmaterial in the form of cobbles and boulders is available close to

the site. Typologically and technologically the site can be placed in Lower Palaeolithic period.

The site, *Sharda Temple-IV* (24° 15′ 36″ N ; 80° 43′ 2″ E) is situated about 150 m north of the Maihar-Sharda Temple road. At present, this site is on two high relief weathered rocks on the right bank of Lilji nala (northern branch) and a chain of hills is present on its north-west side (Plate VII). These mounds would have been one at the time of its occupation and later rain gully divided it into two. The geological sequence at the site is almost similar to the sequences noticed at Sharda Temple-II and Sharda Temple-III (Fig. 39). The size of the site is (27×15) m$+(15\times3)$ m, and north-south oriented. The distribution of artifacts is not even and have a thin patination. Mostly artifacts are fresh and slightly abraded, though a few moderately and heavily abraded artifacts are also present. However, on the basis of topography and physical condition of the site, this site can be placed in primary context. Further, to collect artifacts the site was divided into three strata for stratified random sampling procedure. These strata are—Stratum Ia, Ib and II. The stratum-II was laid on the eastern and northern slope of strata Ia and Ib, and the stratum-II looks like the English alphabet 'L' (Fig. 42). Thereafter, the site was divided into 3×3 m sampling units, which produced 50 sampling units. Out of these units, an independent random sample was selected for 10% sample collection from each stratum. These sampled units for strata Ia ; Ib and II were 3, 19 ; 6, 11 and 3, respectively. These sampled units consisted of 20, 13, 10, 9 and 15 artifacts, respectively. Thus, a total of 67 artifacts was collected at the site. The artifacts are fashioned on quartzite and the rawmaterial in the form of boulders and cobbles is present close to the site. Typologically and technologically it can be assigned to Lower Palaeolithic period.

The *Rampur-II* (24° 17′ 30″ N ; 80° 42′ 35″ E) is situated about 1.5 km north of Sharda Temple. The artifacts are lying over the exposed lower gravel on north-west side of Lilji section (Plate VIII) and closely a chain of hills is present. The physical condition of artifacts suggests that most of the artifacts are heavily abraded and bear sign of water rolling. The size of the occurrence is about 30 m$\times$9 m and east-west oriented. The distribution of artifacts is not even. The topography and physical condition of the occurrence suggest that the artifacts are in secondary context. However, to compare this assemblage from other primary context sites, a 10% sample was collected. Further, the exposed surface was divisible into two strata, therefore, stratified random sampling procedure was adopted. The occurrence was divided into two strata-I and II (Fig. 43). Further each stratum was divided into 3 m$\times$3 m sampling units which produced 30 (20+10) sampling units. The independent random sampled units for stratum-I and stratum-II were 17, 9 and 1, respectively. These sampled units consisted of 10, 6 and 6 artifacts, respectively. A total of 22 artifacts was collected at the occurrence. The artifacts are fashioned on quartzite. Typologically and technologically this site can be placed in Lower Palaeolithic period.

The site, *Rampur-I* (24° 17′ N ; 80° 42′ 40″ E) is situated about 1 km north of Sharda Temple. It is a high relief weathered rock and present a chain of hills on its north-west side. Lilji nala is about 300 m north of this site. No geological sequence is available at the site. The size of the site is about 16 m × 10 m and east-west oriented. The physical condition of the artifacts is fresh or slightly abraded. The distribution of artifacts is not even. On the basis of the physical condition of artifacts and topography this can be classified as a primary context site. Following the simple random sampling procedure, the site was divided into 2 m × 2 m sampling units, which produced 40 sampling units. Out of which about 10% sample was collected through four random samples—24, 33, 14 and 12 (Fig. 44). There was no artifact in the sample no. 33, while the rest consisted of 3, 6 and 5 artifacts, respectively. Thus, a total of 14 artifacts was collected at the site. Mostly artifacts are fashioned on quartzite. A few cobbles and boulders are available close to the site. Typologically and technologically this site belongs to Middle Palaeolithic period.

The site, *Sharda Temple-Ia* (24° 15′ 30″ N; 80° 43′ E) is situated on the same location rather on the site of Sharda Temple-I. But its size is only about 6 m x 5 m and east-west oriented. The distribution of artifacts is not even. Most of the artifacts are fresh and heavily patinated. Topography and physical condition revealed the primary context nature of the site. Following the simple random sampling procedure, the site was divided into 1 m × 1 m sampling units, which produced 30 sampling units. Out of which about 10% sample was collected through the random sample units—9, 4 and 26. These units consisted of 70, 250 and 131 artifacts, respectively (Fig. 45). Thus, a total of 451 artifacts was collected at the site. The artifacts are mainly fashioned on chalcedony, agate, chert and carnalian. Typologically and technologically the site can be placed in Mesolithic period.

Findings outside the sampled units

Outside the random sampled units, two occurrences and one site were also noticed. The two alluvial occurrences are Mansva Ghat and Arahnia Ghat in Madhogarh village. The third site is Hanumanganj north of village Rampur.

Mansava ghat is about 100 m north of Satna-Rewa road. At this place artifacts were found embeded at the bottom of Mansva Ghat section (Fig. 19). Such situation was observed for a distance of about 50 m. It was noticed that the artifacts are generally embeded in lowest band of graded gravel of 0.5 m thick (Plate V). Therefore, an area of about 50 m x 0.50 m was marked on the section and divided into 10 sampling units of 5 m x 0.5 m each. Thereafter, a random number 3 was selected and all artifacts embeded in that sampled unit were extracted. Thus, the total

number of artifacts collected was 9 (Fig. 46). Analysis of these 9 artifacts suggest that most of these artifacts are relatively fresh to some of rolled artifacts. The artifacts are made on quartzite. Typologically and technologically relatively fresh artifacts can be grouped in Middle Palaeolithic period, while the rolled artifacts show resemblance with Lower Palaeolithic artifacts.

The artifacts of *Arahnia Ghat* typologically and technologically can be placed in Lower Palaeolithic period. These are lying on the exposed river bed and about 200 m south of the Satna-Rewa road (Plate IX). To make a proper comparison with those of Mansva Ghat artifacts, a random sample of 5 m × 5 m (sample unit no. 4) was collected out of 50 m × 5 m area. The total number of artifacts collected was 12 (Fig. 47). These rolled artifacts show a close resemblance with those rolled artifacts found at the bottom of Mansava Ghat section. The artifacts are fashioned on quartzite.

The site, *Hanumanganj* (24° 34′ 20″ N ; 81° 3′ 20″ E) is situated on the north of village Rampur and about 1 km north of Satna-Rewa road. It is on a flat mound. The geological sequence observed on the exposed side of the mound suggest two deposits—at the bottom about 50 cm thick yellowish-red silt having a few $CaCO_3$ and iron nodules and the second blackish sandy silt of about 20 cm thick capped by about 15 cm thick humus layer (Fig. 48). It appears that these artifacts at the site are associated with blackish sandy silt. The artifacts are fresh and patinated. The size of the site is 4 m × 5 m and north-south oriented. Topography and physical condition of artifacts suggest primary context nature of the site. Following simple random sampling procedure the site was divided into 1 m × 1 m sampling units which produced 20 sampling units. Out of which 10% sample was collected through the random sample units 9 and 4. These units consisted of 119 and 111 artifacts, respectively (Fig. 49). Thus, a total of 230 artifacts was collected at the site. Mostly artifacts are made on chalcedony, agate, chert and carnalian. Typologically and technologically the site can be placed in Mesolithic period.

The sites and occurrences which are outside the sampled units and those occurrences which are present within the sampled units will not be considered for further analysis. Moreover, a detailed analysis of artifacts will be made only for Lower Palaeolithic sites. However, all sites and occurrences, whether within the sampled units or outside, will be used for general interpretation.

Notes

1. After excluding the portions of sample units 30, 51, 61, 62, 71 and 72, which are outside the district of Satna.
2. These selected random numbers are mentioned here in the same order as present in the random number table. Hereafter, they will be mentioned serially.

LIST OF FIGURES AND PLATES

Figures

Plates

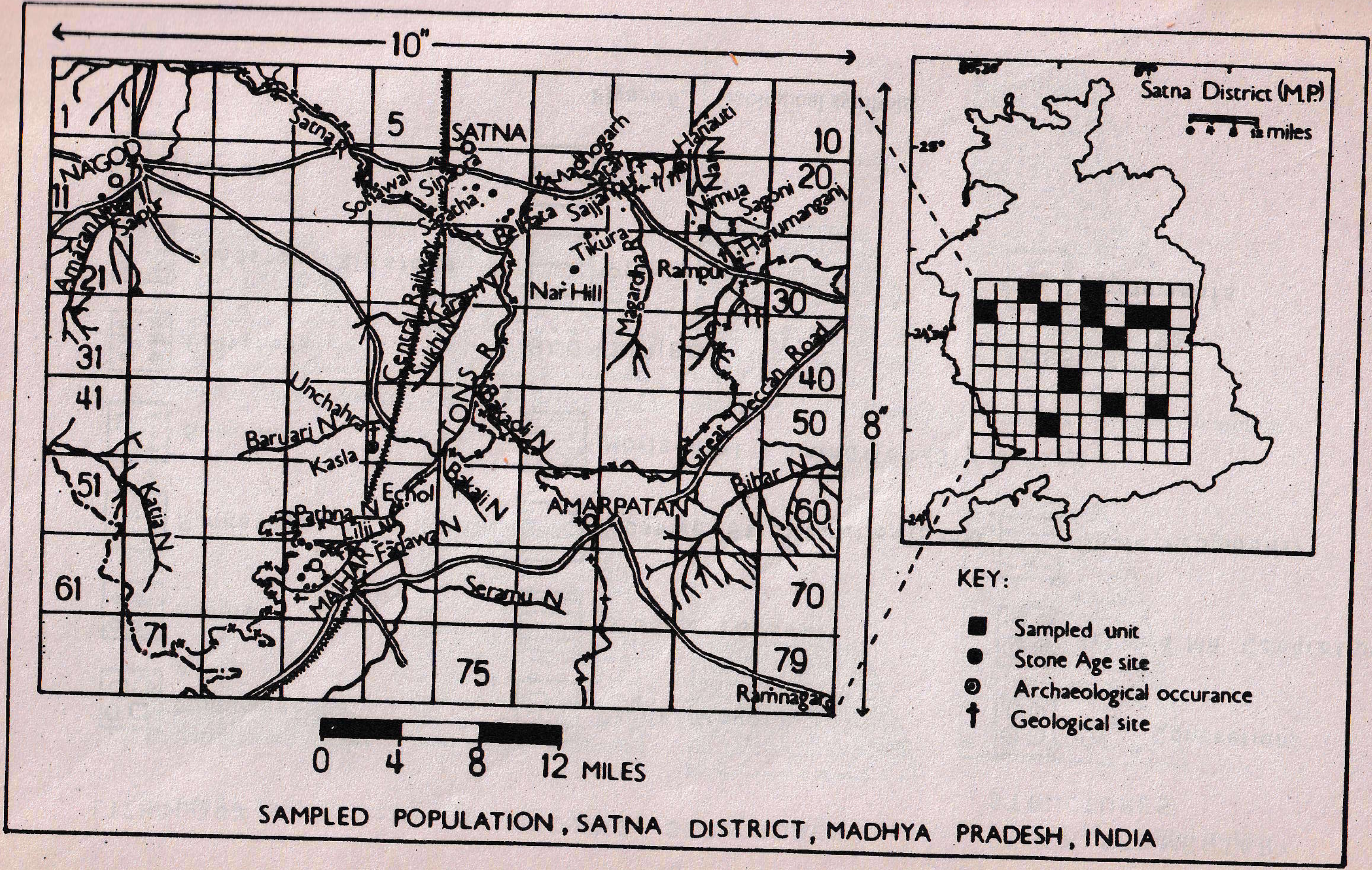

Figure 5. Sampled population : study area, M.P.

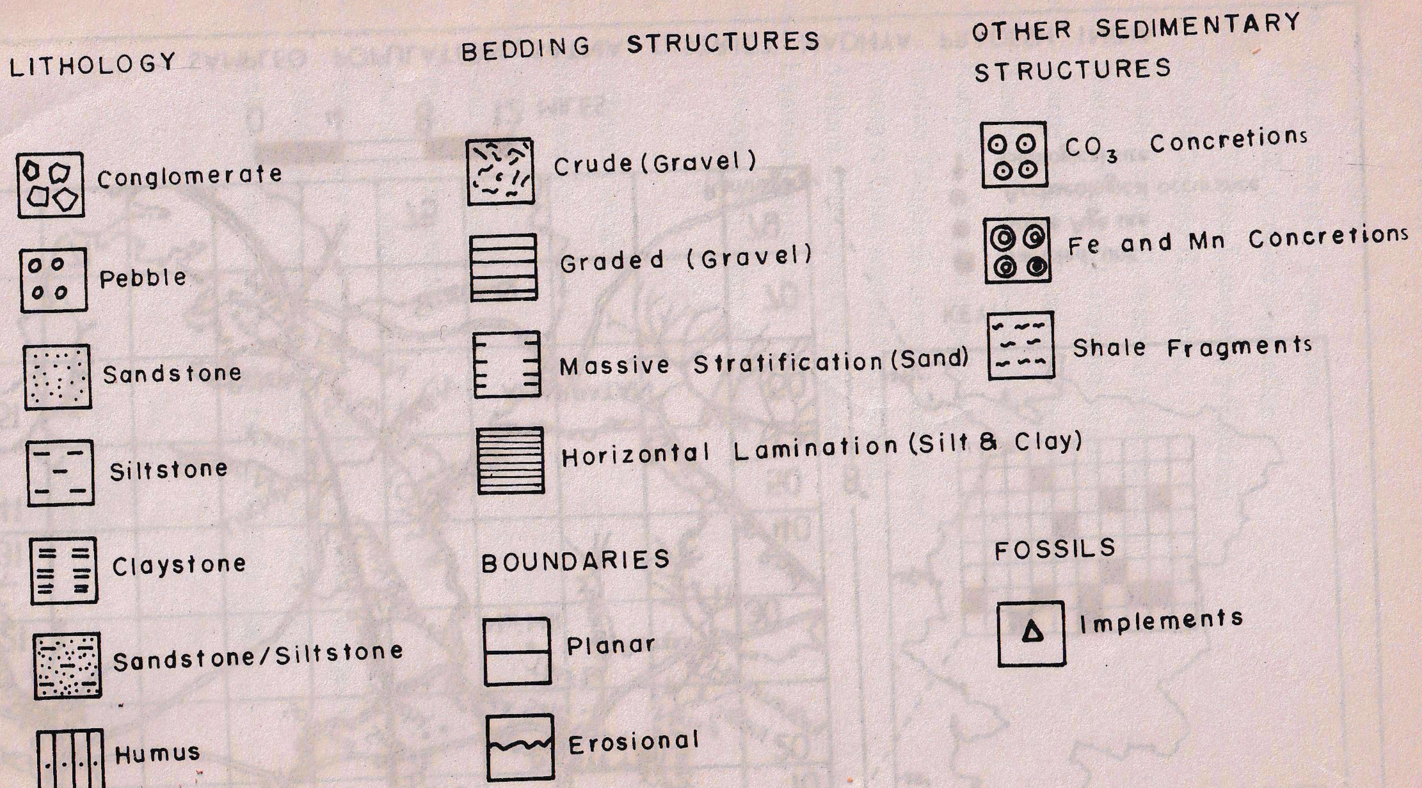

Figure 6. Geological symbols.

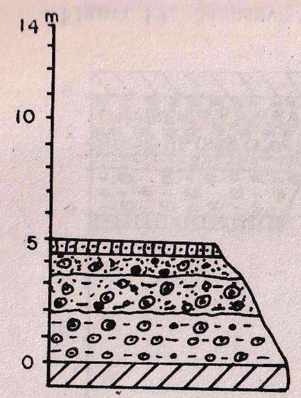

Figure 7. Rajabar section.

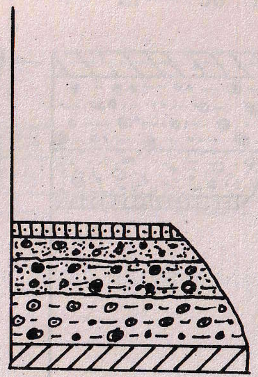

Figure 8. Saipur section.

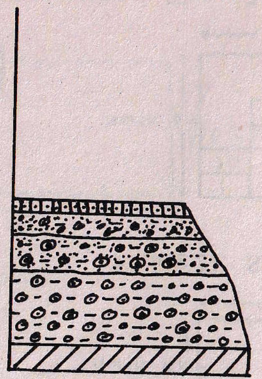

Figure 9. Sohawal section.

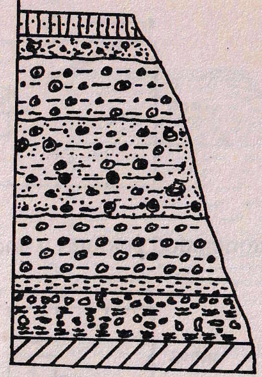

Figure 10. Madhogarh section.

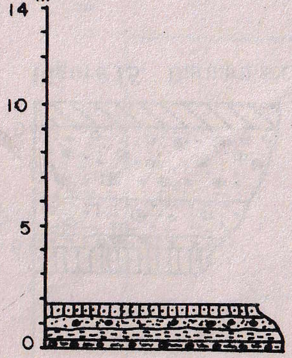

Figure 11. Sajjanpur section.

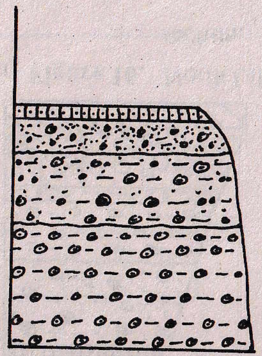

Figure 12. Satari section.

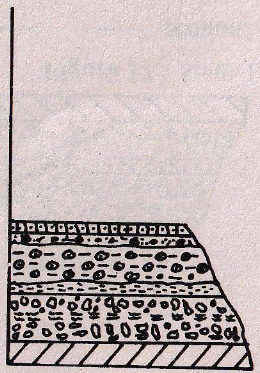

Figure 13. Hinouti section.

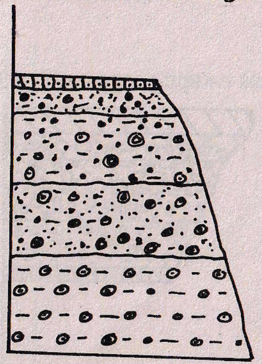

Figure 14. Sagoni section.

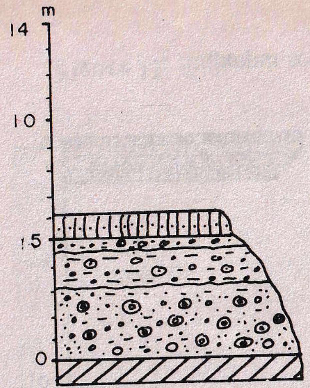

Figure 15. Baruaru section.

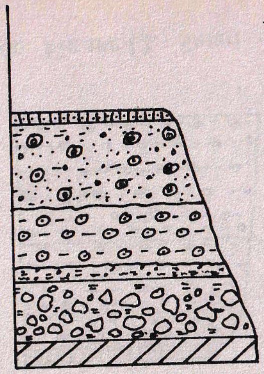

Figure 16. North Lilji section.

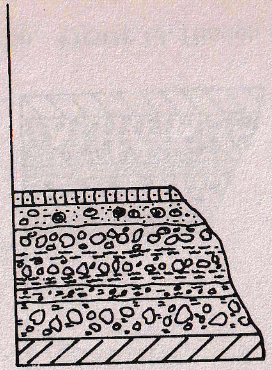

Figure 17. South Lilji section.

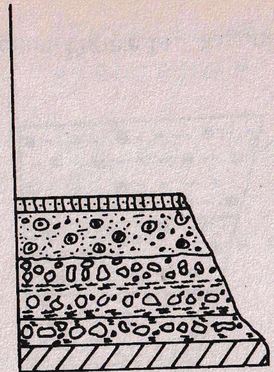

Figure 18. Fadawa section.

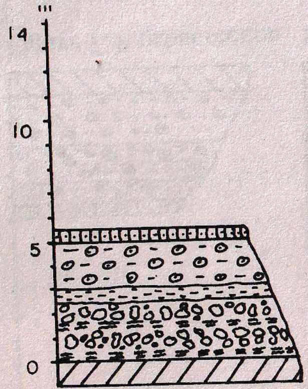

Figure 19. Mansava Ghat section.

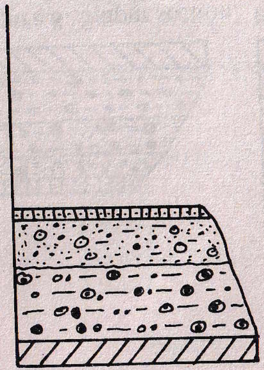

Figure 20. Rampur section.

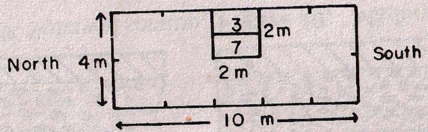

Figure 21. Saipur-I, sampled population.

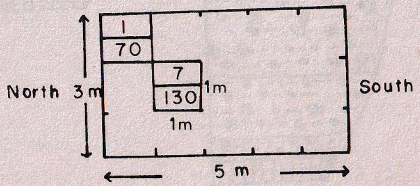

Figure 22. Saipur-II, sampled population.

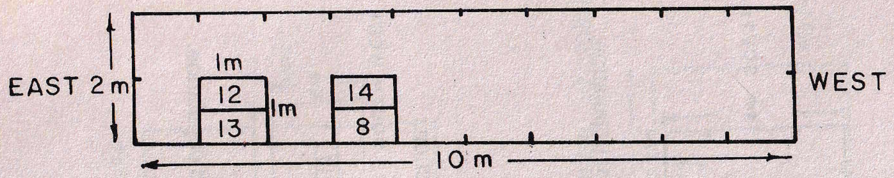

Figure 23. Saipur-III, Sampled population.

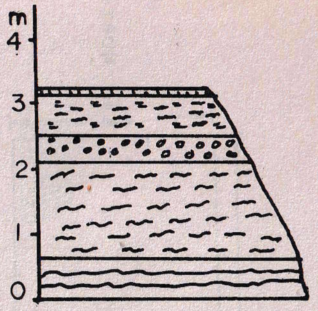

Figure 24. Sagatha section.

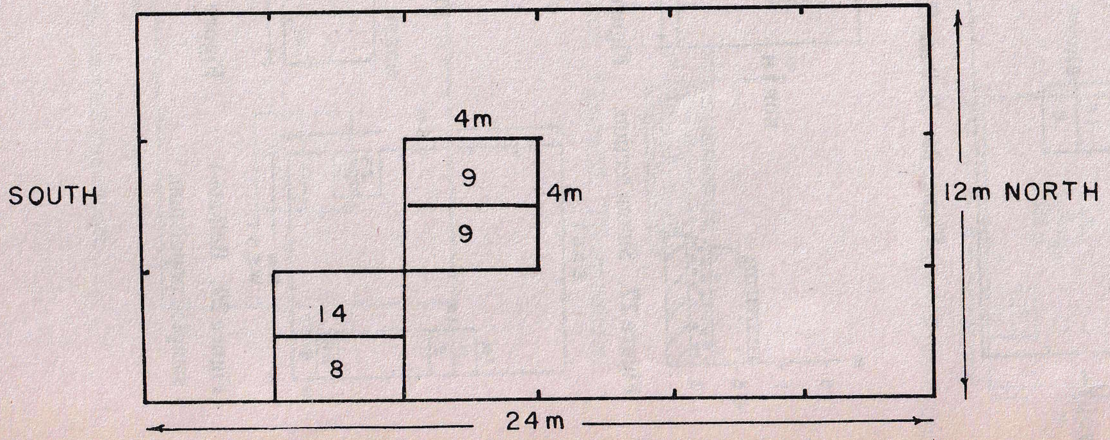

Figure 25. Sagatha, sampled population.

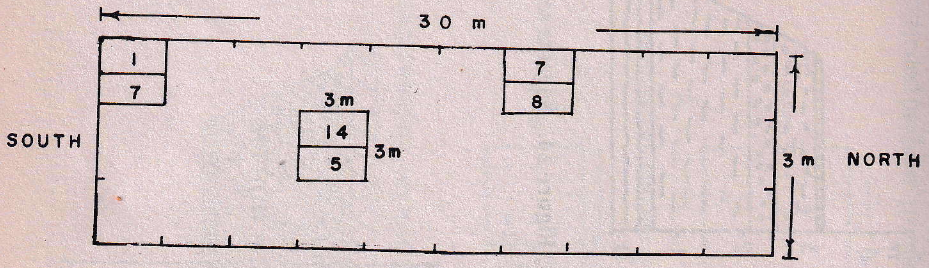

Figure 26. Belhata-II, sampled population.

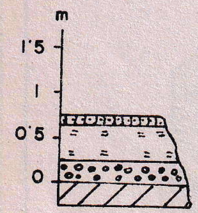

Figure 27. Sinora section.

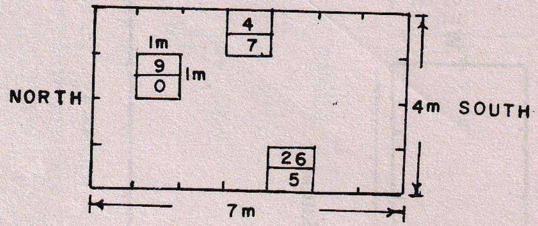

Figure 28. Sinora, sampled population.

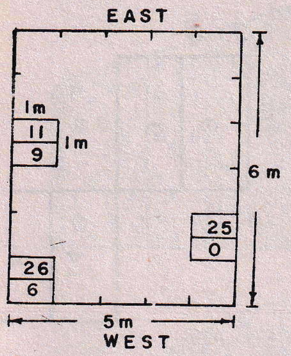

Figure 29. Belhata-I sampled population.

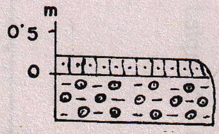

Figure 30. Nimua section.

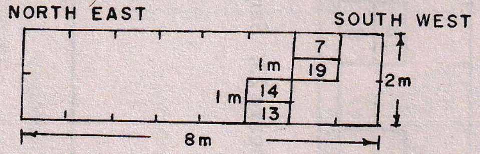

Figure 31. Nimua, sampled population.

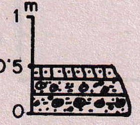

Figure 32. Sagoni-I, section

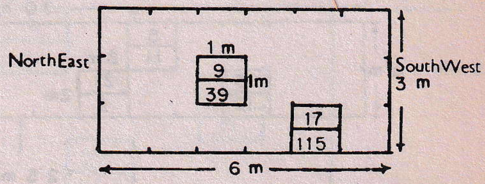

Figure 33. Sagoni-I, sampled population.

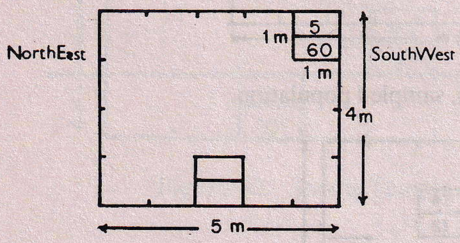

Figure 34. Sagoni-II,sampled population.

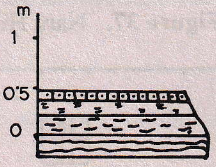

Figure 35. Tikura section.

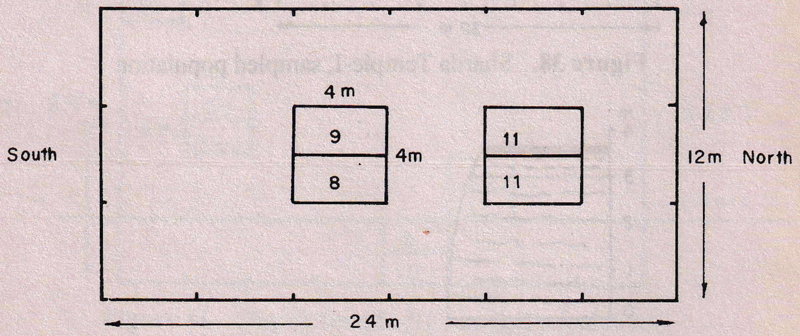

Figure 36. Tikura, sampled population.

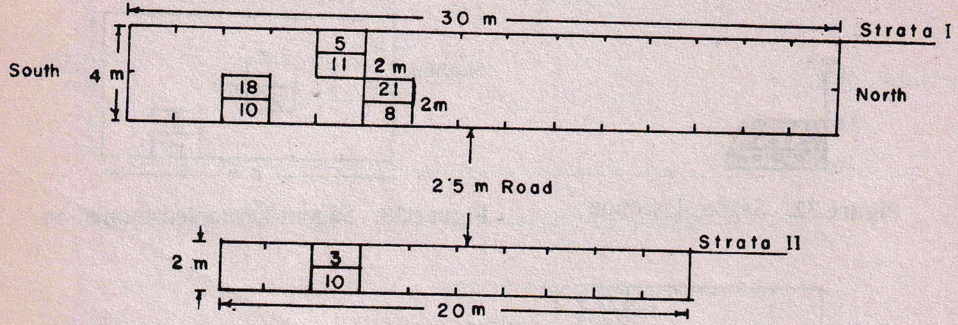

Figure 37. Naru Hill, sampled population.

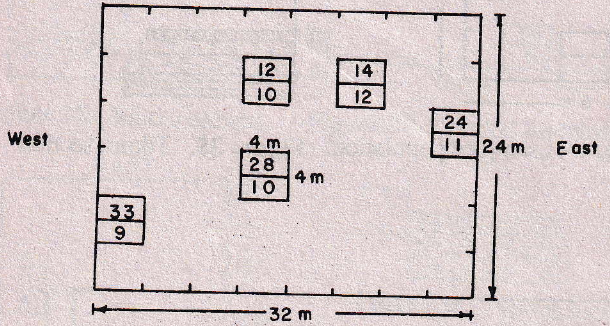

Figure 38. Sharda Temple-I, sampled population

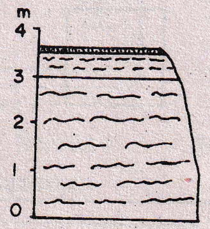

Figure 39. Sharda Temple-II, section.

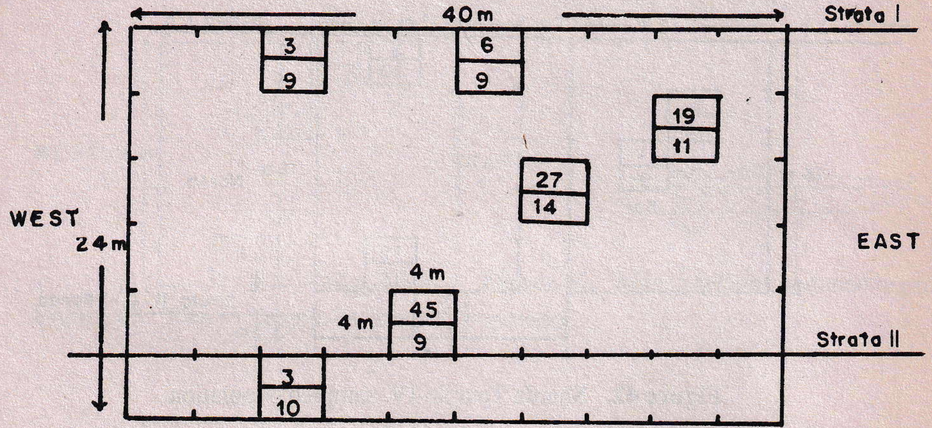

Figure 40. Sharda Temple-II, sampled population.

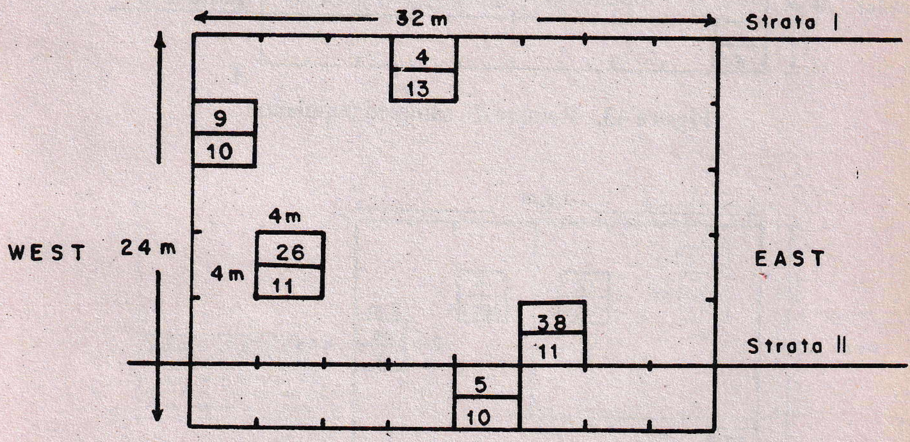

Figure 41. Shardā Temple-III, sampled population.

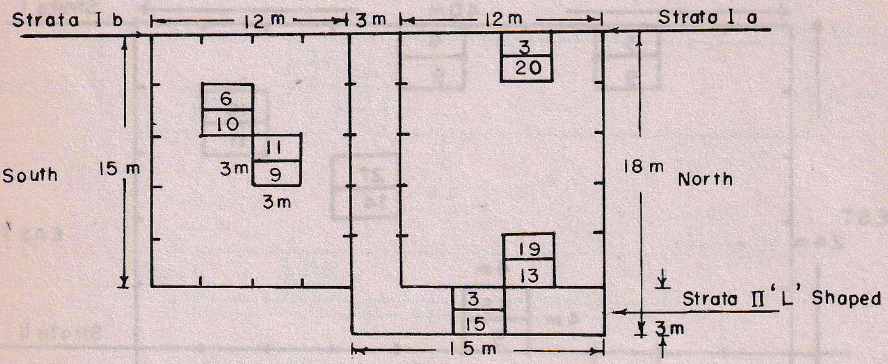

Figure 42. Sharda Temple-IV, sampled population.

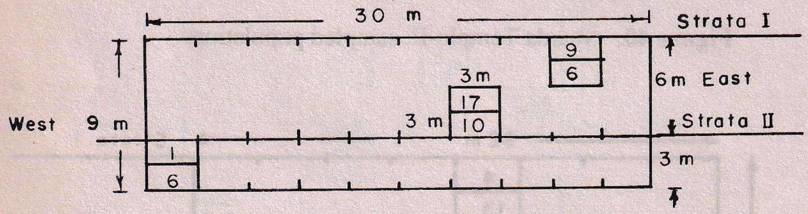

Figure 43. Rampur-II, sampled population.

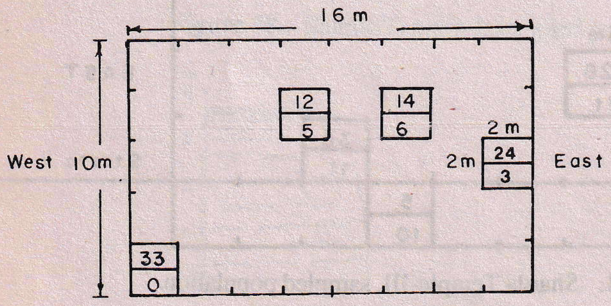

Figure 44. Rampur-I, sampled population.

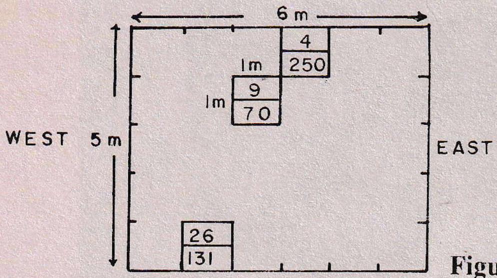

Figure 45. Sharda Temple-Ia, sampled population.

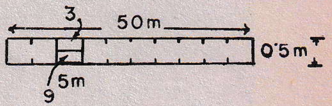

Figure 46. Mansava Ghat, sampled population.

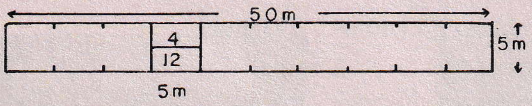

Figure 47. Arahnia Ghat, sampled population.

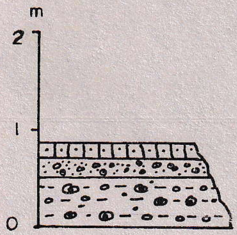

Figure 48. Hanumanganj section

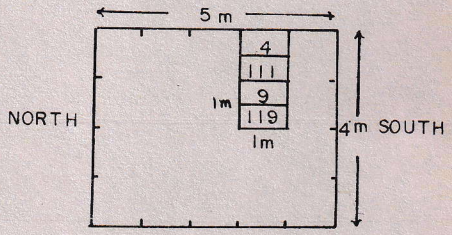

Figure 49. Hanumanganj, sampled population.

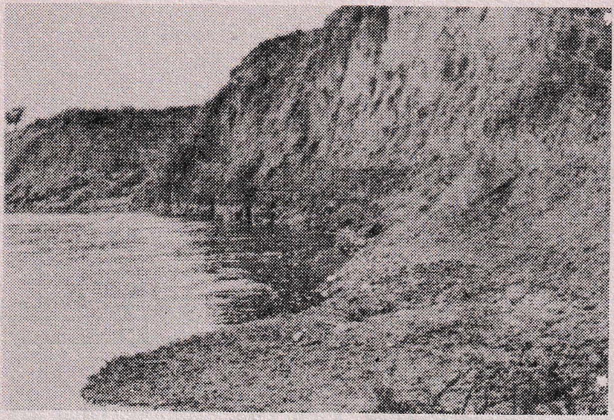

Plate I. Madhogarh section.

Plate II. Satari section.

Plate III. Sagoni section.

Plate IV. North Lilji section.

Plate V. Mansava Ghat section.

Plate VI. General view showing chain of hills at Sharda Temple-I.

Plate VII. General view showing chain of hills at Sharda Temple- IV.

Plate VIII. Tools lying over exposed lower gravel at Rampur-II.

Plate IX. Tools lying over exposed river bed at Arahnia Ghat.

5 Alluvial Stratigraphy of the Upper Tons Valley

Introduction

The river, Tons is the main drainage system of the study area. As stated earlier (chapter-3) the major portion of the Upper Tons is present in our study area. Besides this main river the region is also drained by its tributaries and sub-tributaries. The main tributaries and sub-tributaries in the study area are Satna river, Amaran river, Sukhi nala, Baruaru nala, Simrawal nadi, Magardha river, Nat nala, Lilji nala, Fadawa nala and Seramu nala (see chapter-3).

To build up a preliminary alluvial stratigraphy of the Upper Tons valley, all portion of the river Tons and its tributaries and sub-tributaries which are present in the sampled units of our study area (sampled population) were examined in detail. A distance of about 4.5 km, 9 km, 1 km, 1 km, 3 km, 3 km, 0.5 km, 12 km, and 0.5 km on the river Tons, river Satna, river Amaran, river Magardha, Nat nala, Baruaru nala, Patpara nala, Lilji nala and Fadawa nala were examined, respectively. The cliff sections examined in different sampled units on various drainage systems have been grouped into sections like Rajabar, Saipur, Sohawal. Madhogarh, Sajjanpur, Satari, Hinouti, Sagoni, Baruaru, north Lilji, south Lilji, Fadawa, Mansava ghat and Rampur nala. (see chapter-4). The combined study of these sections suggest that in all eight types of deposits are present, though number of deposits and sequences vary from place to place. Hence, it can be said that depositional sequences comprise either two or more deposits with varying height are visible on the river Tons from Rampur in the north-east to Maihar in the south and covers a crow-fly distance of about 50 km. The depositional sequence of these eight deposits is more clear at the following places (see chapter-4).

i. *Rampur section.* This section is on the right bank of local nala and about 1 km west of Rampur village proper.

ii. *Sagoni section.* This section is on the left bank of the nala Nat and 2 km downstream from the bridge on Satna-Rewa road.

iii. *Madhogarh section.* This section is on the left bank of Tons, 0.5 km from the bridge on Satna-Rewa road and west of Madhogarh village proper.

iv. *Satari section.* This section is on the left bank of Tons and north of Satari village.

v. *Mansava Ghat section.* This section is on the right bank of Tons and north of Madhogarh village proper.

vi. *Lilji section.* This section is on the ıight bank of Lilji nala and 2 km north of Sharda Temple.

Geological formations

The regional dip of a few degrees north provides steep south facing scarp-slopes and gentle north facing dip slopes. The river Tons has a well defined narrow and deep channel. Further it has a gentle longitudinal gradient and dominantly suspended load of clay and silt sized particles. These features suggest that it is a high-sinuosity river (Schumn, 1977 : 154-6). The study of above mentioned six type sections with the aid of other observed sections suggest that these eight deposits can be grouped into six formations on the basis of unconformity i. e. erosional activity, change in the colour and contents of these deposits. Further, these formations have been named after the place name where they are more clear and well exposed. These six formations in the ascending stratigraphic order are :

vi. Rampur formation.
v. Sagoni formation.
iv. Madhogarh formation.
iii. Satari formation.
ii. Mansava Ghat formation.
i. Sharda formation.

Sharda formation

This formation has the maximum exposed thickness of 3 m and consists of two members. The lower member consists of 2.5 m thick angular and sub-angular to rounded clasts of sandstone, shale and quartzite ranging in size from sand sized grains to boulders upto 50 cm in diameter, set in a matrix of clay. These clasts are loose and crudely graded, rather no grading took place. This member is resting on weathered rock and overlain by upper member. Between these two members no sign of erosional activity was noticed. This upper member is composed of 0.5 m thick grey and red brown silty clay, sporadic pebble-sized clasts of sandstones, shales and quartzites. The absence of any sedimentation, haphazard arrangement of clasts and their angular forms suggest that

in the formation of these two members river did not play any role rather it is a mass-wasting (mass-movement) gravel (Schumm, 1967 : 560-61; King, 1975 : 117-30 ; Bloom, 1979 : 163-96). Thus it is a colluvial formation (Fig. 50-A).

The Lower Palaeolithic artifacts are embeded in the upper portion of the lower member. These artifacts are heavily abraded and bear no sign of water rolling.

This formation has been observed for a distance of about 3 km, 4 km and 4 km on the nala Lilji in the north, south and east of Sharda Temple, respectively and for about 0.5 km on the Fadawa nala extreme south-east of Sharda Temple (see chapter-4).

Mansava Ghat formation

This formation has the maximum exposed thickness of 3 m and comprises two members. The lower member consists of 2.5 m thick sub-angular to rounded clasts of sandstone, shale and quartzite, ranging from sand sized grains to cobble upto 15 cm diameter, set in matrix of greyish brown clay. This member is very well graded in bands of cobble-clay and weathered shale deposits. Though, loose in contrast to the cemented gravel-II of Belan valley (Sharma 1973 : 106-10 ; Misra, 1977 : 30). This Mansava Ghat formation rests on the preceding Sharda formation. The undulating surface between these formations suggests that there had been an erosional activity before the formation of the latter, Mansava Ghat formation. The upper member of Mansava Ghat formation rests on the lower member without any break. Further this upper member consist of 0.5 m thick yellowish silt and pebble sized clasts of sandstone, shale and quartzite. The clasts are arranged according to the flow of the water current. The presence of sedimentation, regular arrangement of clasts and shale fragments in bands and presence of sub-angular to rounded cobbles suggest that in the formation of these two members river did play a role. Therefore, these are riverine deposits and in other words it is a fluvial formation (Fig. 50-B).

At the bottom of the lower member of this formation mixed Lower and Middle Palaeolithic stone artifacts have been recovered. However, Middle Palaeolithic artifacts are comparatively fresh than those of the Lower Palaeolithic.

This formation has been observed for a distance of about 3 km, 0.5 km, 4 km, 1 km and 0.5 km on the river Tons in the village Madhogarh ; on the nala, locally known as Patpara nala, in the village Hinouti ; on the Lilji nala, south of Sharda Temple ; on the Magardha river in the village Sajjanpur and on the Fadawa nala, extreme south-east of Sharda Temple, respectively (see chapter-4).

Satari formation

This formation has the maximum exposed thickness of about 5 m and rests on the preceding Mansava Ghat formation. The available evidences show that there had been an erosional activity before the deposition of Satari formation. This is revealed by the presence of undulating surface between Satari and preceding Mansava Ghat formation.

This formation consists of only one member. It is a yellowish silt with well cemented $CaCO_3$ nodules ranging from 1 cm to 5 cm in diameter with minor concentration of sandstone, shale, quartzite and chert. This is a well sedimented formation which suggest a riverine origin. Therefore it is also a fluvial deposit (Fig. 50-C).

The late Upper Palaeolithic artifacts have been found lying over this formation (see chapter-4).

This formation has been observed for a distance of about 4.5 km ; 4 km ; 9 km ; 3 km ; and 7 km on the river Tons in the village Madhogarh and Satari ; on the river Satna in the village Rajabar and Sohawal ; on the river Amaran in the village Saipur ; on the Nat nala in the village Sagoni ; and on the north and east Lilji nala, respectively. (see chapter-4).

Madhogarh formation

This formation has the maximum exposed thickness of about 4 m and rests on the Satari formation. The undulating surface between Madhogarh and Satari formations suggest that an erosional activity had taken place before the Madhogarh formation. This Madhogarh formation is a dark reddish sandy silt which comprises of medium to very coarse sand granules and pebbles. This formation is partly cemented by iron and manganese which give characteristic colour to this formation. This is a well sedimented formation, suggesting thereby riverine origin. Therefore it is also a fluvial formation (Fig. 50-D).

Unfortunately, no archaeological material was found in course of scrapping or survey.

Such type of formation has been observed for a distance of about 9 km ; 1 km ; 3 km ; 3 km ; 3 km ; 12 km ; and 0.5 km on the river Satna in the village Rajabar and Sohawal ; on the Amaran river in the village Saipur ; on the river Tons in the village Madhogarh ; on the Nat nala in the village Sagoni ; on the Baruaru nala in the village Baruaru ; on the north, south and east Lilji nala ; and on the Fadawa nala, respectively (see chapter-4).

Sagoni formation

The maximum exposed thickness of this formation is 3 m and made of only one member. This formation rests on the undulating surface of Madhogarh formation. This suggest that there had been an erosional activity before the Sagoni formation. This is a yellowish red silt, which comprises pebbles and nodules of $CaCO_3$, iron and manganese. In contrast to Madhogarh formation the percentage of iron and manganese nodule is very low. Moreover, it is not cemented like those of Satari formation. It is a well sedimented formation which suggests its riverine origin. Therefore, it is also a fluvial deposit (Fig. 50-E).

In course of scraping section a few microliths were recovered from this formation.

This formation was observed for a distance of about 3.5 km ; 3 km ; 3 km and 0.5 km on the river Tons in the village Madhogarh and Satari ; on the Nat nala in the village Sagoni ; on the nala Baruaru in the village Baruaru and local nala (Rampur nala) in the village Rampur, respectively (see chapter-4).

Rampur formation

The exposed maximum thickness of this formation is 2 m and consists of only one member. It rests on the Sagoni formation. The undulating top surface of Sagoni formation suggests that there had been an erosional activity before the Rampur formation. It is a blackish sandy silt deposit comprising small pebbles and a few granules of $CaCO_3$. A well sedimentation and sub-horizontal lamination of $CaCO_3$ and pebbles suggests riverine origin. Therefore, it is also a fluvial deposit (Fig. 50-F).

From this formation microliths were recovered in course of scraping sections, as well as a few Mesolithic (microlithic) sites were also noticed lying over or within this formation (see chapter-4).

Such type of formation has been noticed for a distance of about 9 km ; 1 km ; 3.5 km ; 1 km ; 3 km ; 3 km and 0.5 km on the river Satna in the village Rajabar and Sohawal ; on the river Amaran in the village Saipur ; on the river Tons in the village Madhogarh and Satari ; on the river Magardha in the village Sajjanpur ; on the Nat nala in the village Sagoni ; on the nala Baruaru in the village Baruaru and on the local nala in the village Rampur, respectively (see chapter-4).

Type sections

The sequence of these six formations observed at type sections are as follows ;

Lilji section

This type section is situated on the right bank of Lilji nala (north branch) about 2 km north of Sharda Temple. The sequences at this section from bottom to top are : on the weathered rock rests 2.5 m thick lower member of Sharda formation which is overlain by the upper member of Sharda formation of about 0.5 m thick. The upper member of Sharda formation is capped by unconfirmably 3.5 m thick Satari formation. About 3.5 thick deposit of Madhogarh formation rests unconfirmably on the Satari formation. This Madhogarh formation is finally overlain by a humus layer of 50 m thick (Fig. 16 ; Plate IV). Thus, the total height of this type section observed is 10.5 m.

Mansava Ghat section

This type section is situated on the right bank of the river Tons and north of the village Madhogarh proper. The sequences at this section from bottom to top are—on the eroded bed rock rests a 2.5 m thick lower member of Mansava Ghat formation and overlain by about 0.5 m thick upper member of Mansava Ghat formation. Above the upper member of Mansava Ghat formation rests unconfirmably about 2 m thick Satari formation which is capped by a 50 cm thick humus layer (Fig. 19 ; Plate V). Thus, the total height of Mansava Ghat section is 5.5 m.

Satari section

This type of section is situated on the left bank of Tons and north of Satari village proper. The sequences at this section from bottom to top are—at the bottom about 5 m thick Satari formation is resting on the bed rock. About 3 m thick Sagoni formation is present unconfirmably on the Satari formation. On this Sagoni formation rests unconfirmably about 1.5 m thick Rampur formation, and this last formation is capped by a humus layer of 0.5 m thick (Fig. 12 ; Plate II). A total height of Satari section is about 10 m.

Madhogarh section

This type of section is situated on thc left bank of the river Tons, about 0.5 km south of bridge on Satna-Rewa road and west of Madhogarh village proper. The sequences at this type section from bottom to top are—

About 2 m thick lower member of Mansava Ghat formation rests on the eroded bed rock, which is overlain by a 0.5 m thick upper member of Mansava Ghat formation. Above the upper member of Mansava Ghat formation is present unconfirmably Satari formation of about 2.5 m thick. On the Satari formation rests unconfirmably 4 m thick Madhogarh formation. The latter formation is overlain, unconfirmably by 2.5 m thick Sagoni formation.

About 1 m thick Rampur formation is capped by 1 m thick humus layer and rests unconfirmably on the Sagoni formation (Fig. 10 ; Plate I). Thus, a total height of this section is 13.5 m.

Sagoni section

This type section is situated on the left bank of Nat nala, about 2 km down stream from the bridge on Satna-Rewa road. The sequences present at this type section from bottom to top are—

About 4 m thick Satari formation rests unconfirmably on the unexposed ground and is overlain unconfirmably by 3 m thick Madhogarh formation. About 3 m thick Sagoni formation rests unconfirmably on the Madhogarh formation. The Rampur formation of about 1 m thick is capped by 0.5 m thick humus layer and rests unconfirmably on the Sagoni formation (Fig. 14 ; Plate III). The total height of this type section is 11.5 m.

Rampur section

This type section is situated on the right bank of a local nala and about 1 km west of the Rampur village proper. This section reads from bottom to top as—

About 2.5 m thick Sagoni formation rests on the eroded bed rock. This is overlain by unconfirmably Rampur formation of about 2 m thick. This Rampur formation is capped by a 0.5 m thick humus layer (Fig. 20). A total height of this section is 5 m.

Composit geological column

A combined study of different cliff sections leads to the following preliminary observations pertaining to the geological column for the Upper Tons valley. This will be dealt in terms of both deposits and formations (Fig 51). This reads from bottom to top as follows —

On the weathered rock rests colluvial Sharda formation, which is composed of two members—lower and upper. Its maximum exposed thickness is 3 m. The lower member, about 2.5 m thickness is composed of angular to rounded clasts of sandstone, shales and quartzites ranging in size from sand sized grains to boulders upto 50 cm in diameter, set in matrix of clay. This formation is overlain by 0.5 m thick upper member which is composed of grey-red brown silty clay, sporadic pebble sized clasts of sandstones, shales and quartzites. Lower Palaeolithic artifacts are associated with the upper portion of lower member of Sharda formation. Over the Sharda formation rests unconfirmably Mansava Ghat formation. This latter for-

mation is also composed of two members--lower and upper with a total exposed thickness of about 3 m. The lower member of Mansava Ghat formation of about 2.5 m is composed of sub-triangular to rounded clasts of sandstones, shales and quartzites ranging in size from sand sized grains to cobble upto 15 cm in diameter, set in matrix of greyish brown clay. The lower member of Mansava Ghat formation is very well graded in bands of cobble-clay and shale deposit but not consolidated rather it is a loose gravel. It is overlain by upper member of Mansava Ghat formation of about 0.5 m thick which is composed of yellowish silt and pebble sized clasts of sandstones, quartzites and shales. This Mansava Ghat formation is a fluvial formation. From the bottom of the lower member of Mansava Ghat formation both Lower and Middle Palaeolithic artifacts were recovered but a relatively fresh Middle Palaeolithic artifacts than those of Lower Palaeolithic. This formation is succeeded by unconfirmably another fluvial formation i. e., Satari formation, composed of single unit. The maximum exposed thickness of this Satari formation is 5 m. It is composed of well cemented yellowish silt of $CaCO_3$ nodules ranging from 1 cm to 5 cm in diameter with minor concentration of sandstones, shales, quartzites and cherts. This formation is followed by another fluvial formation i. e. Madhogarh formation. The maximum height of Madhogarh formation is 4 m and rests unconfirmably on the Satari formation. This is also a single unit formation of reddish sandy silt and comprises iron and manganese nodules, medium to very coarse sands granules and pebbles. This formation is partly cemented by iron and manganese which provided to this formation its characteristic colour. It is pity no archaeological material could be recovered out of this formation. This formation is again succeeded by 3 m thick fluvial, single unit formation i. e. Sagoni formation. The latter is composed of yellowish-red silt, containing a few loose nodules of $CaCO_3$, iron and manganese. Microliths are associated with this formation. This Sagoni formation rests unconfirmably on the Madhogarh formation. The Sagoni formation is finally overlain by single unit Rampur formation of about 2 m thick. This Rampur formation is a fluvial formation and rests unconfirmably on the Sagoni formation and capped by humus layer. Rampur formation is composed of blackish sandy silt containing small pebbles and granules of $CaCO_3$. The microliths are also associated with this formation. Thus, the total height of composite geological column of the Upper Tons valley, comprising six formations and eight units (deposits) measures 20 m.

Depositional history

Observations and interpretations have been made about the depositional history of a number of valleys in the adjoining regions of the present study area and other parts of India. Mention may be made of Belan valley, Allahabad district, Uttar Pradesh (Sharma, 1973 : 106-10, 1975 : 1-20 ; Misra, 1977 : 30 ; Mujumdar and Rajaguru, 1970 : 96-105), Middle Son valley, Sidhi district, Madhya Pradesh (Williams and Keith, 1983 : 9-21) Upper Son valley

at Barchanda, about 2 km from the Gorai village and 2.5 km of Birsinghpur on the right bank of Johilla, Shahdol district, Madhya Pradesh (Sankalia, 1974 : 113) Narmada valley (Sankalia, 1974 : 113-18), and Quatern ry studies in Rajasthan (Misra, et. al. 1980 : 19-31, 1982 : 72·86 ; Allchin, et. al. 1978 : '4·76). In the Upper Tons valley in all six formations consisting of eight deposits have been noticed in the study area. In the light of investigations and interpretations made in other regions, an attempt is being made to infer the erosional and depositional events that took place in the upper Tons valley in the following order :

In the beginning, a down cutting activity by the river would have created a deep, broad and gradual sloping river valley. Over which in due course of time a colluvial deposit of sandstones, boulders and shales i. e. lower member of Sharda formation might have accumulated. This process was continued for a considerable period and thereafter prehistoric man appeared on the scene. It is evident from the presence of Lower Palaeolithic artifacts in the upper part of lower member of Sharda formation. Again this colluvial aggradational process was continued and upper member of Sharda formation took place. The change in the contents of these two members suggests that there was, probably, some change in the velocity of the wind and that was not enough to accumulate big sized particles in the upper member. Till then the river bed would have risen for a considerable height.

This depositional activity was followed by erosional activity and thereafter aggradation phase and in both the rivers played an important role The latter aggradational phase deposited lower member of Mansava Ghat formation. Further by this time Middle Palaeolithic man had come as is evident from the recovery of Middle Palaeolithic artifacts. The banded deposit of lower member of Mansava Ghat formation suggests that the velocity of river was not constant during the period of its formation. This might have given time to settle the contents in banded form. This process was continued for a considerable period with minor erosion and followed by another aggradational phase of low velocity regime leading to upper member of Mansava Ghat formation. This was followed by another erosional phase which further widened the valley and cut down the Mansava Ghat formation. Subsequently followed by a depositional phase i. e. the Satari formation. The higher precipitation of $CaCO_3$ has given cemented texture to this formation. This process continued with minor erosion. By this time Upper Palaeolithic man had arrived on the scene. From the exposed surface of this formation late Upper Palaeolithic artifacts are obtained at Nimua and Saipur-III.

After this aggradational activity another major erosional activity took place which further widened the valley and cut down the Satari formation. This major erosional activity was followed by another major aggradational activity, resulting in the deposition of Madhogarh formation. This process

continued for a considerable period with some minor erosion and was followed by another erosional phase cutting down into the Madhogarh formation. Thereafter, another fluviatile aggradational phase followed, under which Sagoni formation took place This aggradational process was continued for a considerable period. During this aggradational phase Mesolithic man had appeared on the scene as revealed from the presence of microliths in this formation. Afterwards, another erosional activity took place which cut down the Sagoni formation and followed by the last aggradational phase in the alluvial history of Upper Tons valley, which formed Rampur formation. Mesolithic or later prehistoric men were present during this period as revealed from the presence of microliths in this formation.

Palaeoenvironment

A preliminary statement can be made about the palaeoenvironment of prehistoric people in the study area. It is based on the comparative study of contents between Upper Tons valley formations and the formatlons or deposits reported and interpreted for same purpose in other regions. So that, following the suggestions and interpretations made by scholars like Bull (1972 : 69-71), Williams (1975 : 617-18), Schwertmann (1966 : 645-46) Williams and Keith (1983 : 9-21), Sharma (I973 : 106-10, 1975 : 1-20),Misra (1973 : 58-72), Misra (1977 : 32-33), Misra, et. al. (1980: 19-30, 1982, 72-86), Sankalia (1974 : 113-18),Mujumdar and Rajaguru (1970 : 96-105) about different geological formations or deposits for valleys and regions of their respective study area, the following inferences can be made for Upper Tons valley.

The colluvial gravel, lower member, of Sharda formation suggests a slow mass-wasting (Mass-movement) and erratic rainfall. Therefore, a semi-arid climate can be imagined for this period. The absence of boulder-clay and presence of small pebble sized clasts in the colluvial upper member of Sharda formation suggest a semi-humid condition during this period. The Mansava Ghat formation, consists of fluviatile horizontally graded bands of cobble-gravel (lower member) and yellowish fine silt (upper member) suggests that deposition took place under moderate flow regime. This implies a wet and warm condition during and after the initial phase of aggradation.

The heavy precipitation of $CaCO_3$ in the Satari formation suggest an arid condition during the fluviatile Satari formation. The widespread leaching and precipitation of iron and manganese in the fluviatile Madhogarh formation can be inferred for humid condition. Again relatively less precipitation of $CaCO_3$ and leaching of iron and manganese in the fluviatile Sagoni formation suggest a semi-humid to semi-arid condition. Lastly, the presence of a few $CaCO_3$ in the fluviatile Rampur formation can be inferred for semi-arid condition.

LIST OF FIGURES

Figures

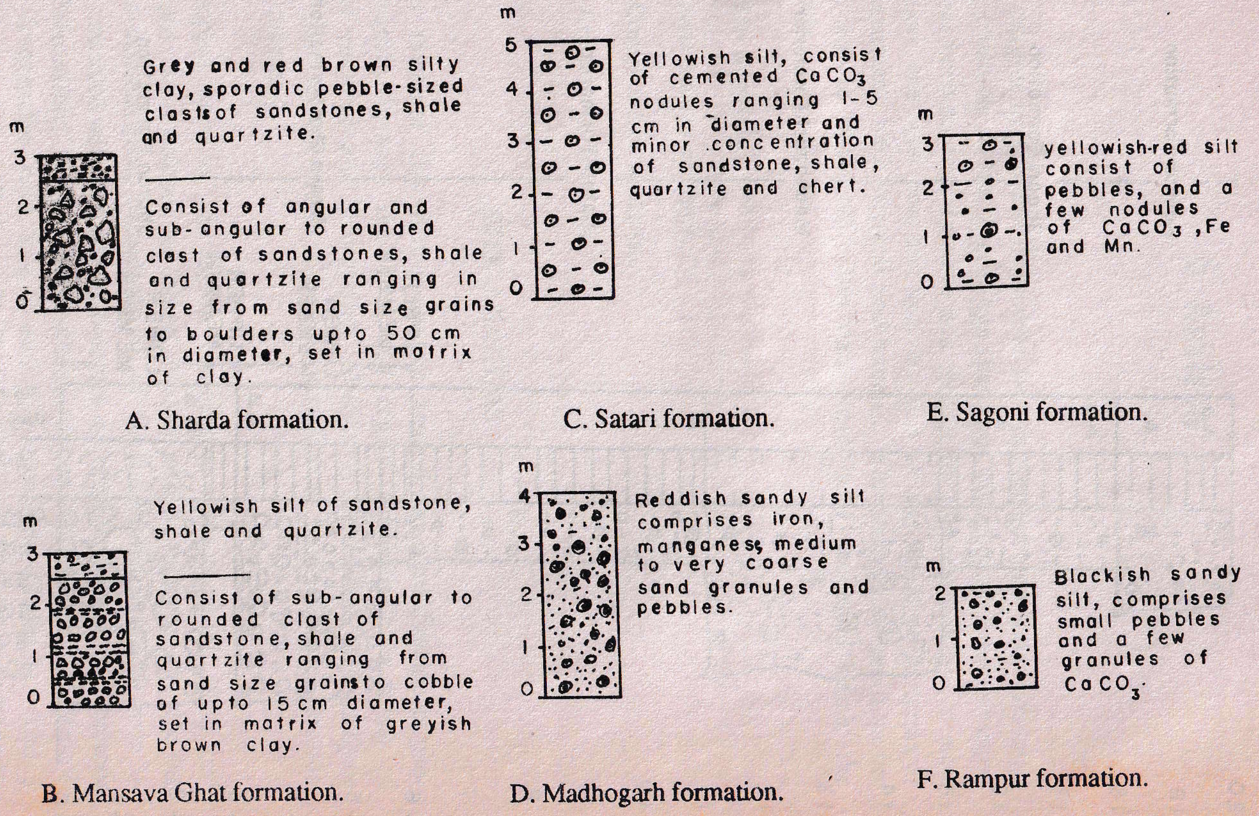

Figure 50. Geological formations Upper Tons Valley, Satna district, Madhya Pradesh.

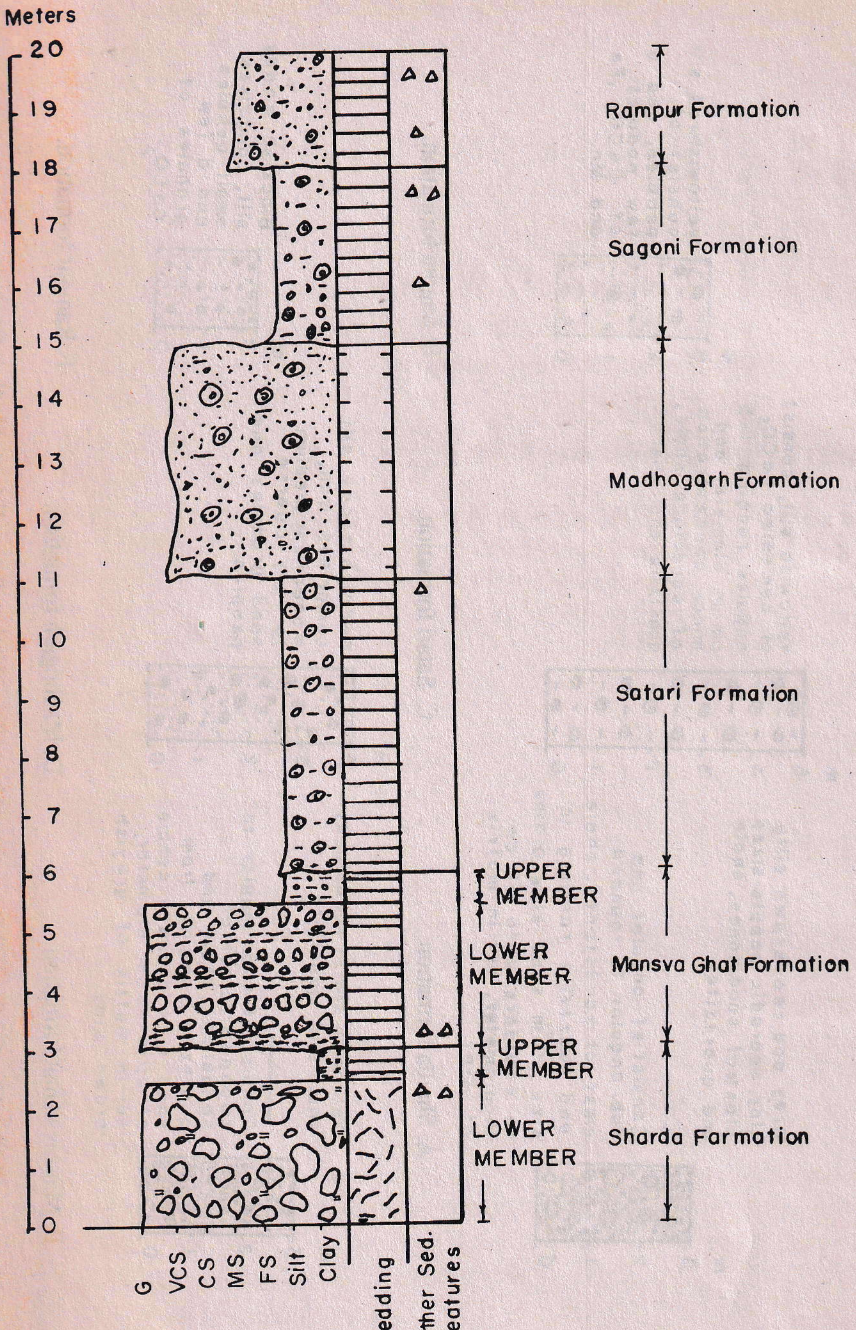

Figure 51. Composite geological column, Upper Tons Valley, Satna district, Madhya Pradesh

6 Analysis

In this chapter we propose to analyse the problem focused data collected in the field pertaining to the Stone Age sites and the associated assemblages. An attempt has been made to retrieve information of the relationships of sites and assemblages and the possible analysis also of the findings in terms of regional environment both physical and human. The analysis is based on the model as set out in chapter-2. The data have been processed under the following heads.

A. Site analysis.

B. Assemblage analysis.

C. Comparative analysis.

D. Analysis of findings.

SITE ANALYSIS

The principal theme of this section centres around the identification of probable relationship between the sites and region particularly in terms of topographical features and potentiality of sites in the region. The analysis of the later part of the theme is based on statistical methods using formula as set out in chapter-2.

The sampled units of the region covering an area of about 491.5 km^2 brought to light the existence of about 18 sites and 3 occurrences. On the basis of typo-technological consideration of the associated artifacts these 18 sites may be classified with considerable degree of confidence into four periods i. e. Lower Palaeolithic, Middle Palaeolithic, Upper Palaeolithic and Mesolithic. Their frequencies read 8, 4, 2 and 4, respectively (Table 2). The 3 occurrences designated as Rampur-II, Kasala Hill and Hinouti appear to be of Lower Palaeolithic period. These occurrences have not been included in the data for further analysis due to low level of confidence of their identity.

Topographical relationship

Lower Palaeolithic sites

All sites are located on the weathered rocks, though on the basis of morphometric features of weathered rocks it can be said that five are on high relief weathered rocks and the rest on the low relief weathered rocks. The nearest water source in four sites is nala and about on average 300 m, while in the rest four sites it is river and varies from 3 km. to 5 km. Five sites are relatively closer to the raw material source.

Middle Palaeolithic sites

These four sites are on weathered rocks. On the basis of morphometric features of weathered rocks three sites are on high relief and one on the low relief weathered rocks. The source of raw material is not close to these sites and only a few boulders and cobbles are available in the adjacent area. For two sites water source, nala as well as river, is about at 0.5 km distance, and in the case of the rest two sites it is river and about 3 km to 5 km.

Late Upper Palaeolithic sites

Both sites are on the flat exposed Satari formation. The raw material is not present in the adjacent area. These sites are about 0.5 km and 1.5 km from the water source, which is in both the case river.

Mesolithic sites

Two sites are on flat mounds and the rest two are on weathered rocks (low/high relief). These sites are close to water source. Three sites are close to nalas and one close to river. Two sites are about 20 m from the nala and the rest two are about 300 m and 600 m from the nala and river, respectively. There is no place close to the sites which can be refered as sources of raw material.

Potentiality of sites

Due to various obvious reasons it is not possible to compute precisely the parameter of the potentiality of sampled population (target population), though some workers have attempted to a considerable degree of satisfaction by using different probability sampling procedure and design (Judge, et. al., 1975). Attempt has also been made to compute the reliability of sample procedure by comparing observed and expected frequencies through *chi-square* test

(Chenhall, 1975 ; Judge, et. al. 1975). These studies, however, are based on known regions.

It has been observed that all types of probability sampling procedures and designs such as random quadrat, random transect, systematic quadrat, interval (systematic) transect, etc. provide almost similar results for the estimation of total number of sites in the given region (Judge, et. al. 1975).

The precision of the estimate in the regional survey (sampled survey) is about 0.151. The standard deviation (SD) of the sampled units for site frequency is 2.06 with the mean of 1.5. If we make a tentative estimation for total number of sites in the sampled population using the above sample mean, the area sampled in question may be expected to provide about 118 sites. However, in view of the standard error of the sample for the variable site reading 0.53, the parameter mean range would be about 15+ (1.96 x 0.53) i.e. 1.5 $\pm$ 1.03 or between 2.5 and 0.48. The frequency of sites in the sampled population is expected to range from 38 to 197.

It has been observed by various scholars (Judge, et. al., 1975) that simple random procedure vary in frequency estimation for the cultural periods (type site), though represents every cultural period. Therefore, no estimation has been computed to know about expected number of Lower Palaeolithic/ Middle Palaeolithic/(late) Upper Palaeolithic or Mesolithic sites.

In this section it is proposed to analyse every Lower Palaeolithic site for artifacts density and parameter range of total number of artifacts. The calculation is based upon the formulas set out in chapter-2 and Appendix-A (Table 3).

Sharda Temple-I (ST-I)

The site of ST-I extended in an area of about 800 m² and east-west oriented being sampled as well as target population, has been divided into 48 units, of these 5 units have been sampled. Each sample unit contains about 16 m² surface. The artifacts density is about 0.65 per m². The mean, standard deviation and standard error of the sampled units is 10.4, 1.14 and 0.47, respectively. The parameter mean of artifacts in 5 units ranges 10.4 $\pm$ 0.92 or between 9.48 and 11.32. On the basis of this mean range, the range of total artifacts at the site varies from 455 to 543. It is closer to the nala than river and source of raw material is relatively close and on its north-west there is a chain of hills.

Sharda Temple-II (ST-II)

The site of ST-II extended in an area of about 960 m² and east-west oriented being sampled as well as target population, has been divided into

60 units. Of these 6 units have been sampled. Each sample unit contains about 16 m² surface. The artifacts density is about 0.64 per m². The mean, standard deviation and standard error is 10.3, 1.96 and 0.75, respectively. The parameter mean of artifacts in 6 units ranges 10.3 ± 1.47 or between 8.8 and 11.8. On the basis of this mean range, the range of total artifacts at the site varies from 528 to 708. It is closer to nala than river and on the north-west there is a chain of hills. The source of raw material is relatively close to the site.

Sharda Temple-III (ST-III)

The site of ST-III extended in an area of about 800 m² and east-west oriented being sampled as well as target population, has been divided into 48 units. Of these 5 units have been sampled. Each sample unit contains about 16 m² surface. The artifacts density is about 0.68 per m². The mean, standard deviation and standard error of the sampled units is 11, 1.22 and 0.50, respectively. The parameter mean of artifacts in 5 units ranges 11 ± 0.98 or between 10.02 and 11.98. On the basis of this mean range, the range of total artifacts at the site varies from 481 to 575. It is closer to nala than the river and on the north-west there is a chain of hills. The source of raw material is relatively close to the site.

Sharda Temple-IV (ST-IV)

The site of ST-IV extended in an area of about 450 m² and north-south oriented being sampled as well as target population, has been divided into 50 units. Of these 5 units have been sampled. Each sample unit contains about 9 m² surface. The artifacts density is about 1.48 per m². The mean, standard deviation and standard error is 13.4, 4.39 and 1.84, respectively. The parameter mean of artifacts in 5 units ranges 13.4 ± 3.6 or between 9.8 and 17. On the basis of this mean range, the range of total artifacts at the site, varies from 490 to 850. It is closer to nala than the river and on the north-west there is a chain of hills. The source of raw material is relatively close to the site.

Naru Hill (NRH)

The site of NRH extended in an area of about 160 m² and north-south oriented being sampled as well as target population has been divided into 40 units. Of these 4 units have been sampled. Each sample unit contains about 4 m² surface. The artifacts density is about 2.43 per m². The mean, standard deviation and standard error of the sampled units is 9.7, 1.25 and 0.58, respectively. The parameter mean of artifacts in 4 units ranges 9.7 ± 1.13 or between 8.6 and 10.8. On the basis of this mean range, the range of total artifacts at the site varies from 344 to 432. It is closer to the river

than nala and it is on the foot of the hill present on its south. The source of raw material is close to the site.

Belhata-II (BHT-II)

The site of BHT-II extended in an area of about 270 m^2 and north-south oriented being sampled as well as target population, has been divided into 30 units. Of these 3 units have been sampled. Each sample unit contains about 9 m^2 surface. The artifacts density is about 0.74 per m^2. The mean, standard deviation and standard error is 6.7, 1.52 and 0.72, respectively. The parameter mean of artifacts in 3 units ranges 6.7 ± 1.41 or between 5.3 and 8.1. On the basis of this mean range, the range of total artifacts at the site varies from 159 to 243. It is closer to the river than nala and relatively located in the open area. The source of raw material is not relatively close to the site.

Sagatha (SGT)

The site of SGT extended in an area of about 288 m^2 and north-south oriented being sampled as well as target population, has been divided into 18 units. Of these 2 units have been sampled. Each sample unit contains about 16 m^2 surface. The artifacts density is about 0.53 per m^2. The mean, standard deviation and standard error of the sampled units is 8.5, 0.70 and 0.43, respectively. The parameter mean of artifacts in 2 units ranges 8.5 ± 0.84 or between 7.7 and 9.3. On the basis of this mean range, the range of total artifacts at the site varies from 139 to 167. It is closer to the river than nala and relatively located in the open area. The source of raw material is not relatively close to the site.

Tikura (TKR)

The site of TKR extended in an area of about 288 m^2 and north-south oriented being sampled as well as target population, has been divided into 18 units. Of these, 2 units have been sampled. Each sample unit contains about 16 m^2 surface. The artifacts density is about 0.59 per m^2. The mean, standard deviation and standard error is 9.5 2.12 and 1.31, respectively. The parameter mean of artifacts in 2 units ranges 9.5 ± 2.56 or between 6.9 and 12 .1. On the basis of this mean range, the range of total artifacts at the site varies from 124 to 218. It is close to the river than nala and located in a relatively open area. The source of raw material is not relatively close to the site.

ASSEMBLAGE ANALYSIS

This section deals with the typo-technological analysis of the artifacts collected from eight sites of the Lower Palaeolithic period. The artifacts of each site

initially classified into shaped tools, modified artifacts and unmodified wastes were further analysed in various tool classes and tool types. Each artifact of every site (assemblage) was further studied for various attributes as set out in chapter-2. The terminology and typology as adopted in this work are stated in chapter-2.

In order to avoid repetition we propose to describe only the main characteristics of the assemblage and artifact attributes instead of describing each and every specimen. However, further details and comprehensive physical description of illustrated specimens have been presented in the relevant tables, figures and plates.

The sites analysed below are the following :

(1) Sharda Temple—I (ST-I), (2) Sharda Temple—II (ST-II), (3) Sharda Temple—III (ST-III), (4) Sharda Temple—IV (ST-IV), (5) Naru Hill (NRH), (6) Belhata—II (BHT-II), (7) Sagatha (SGT), (8) Tikura (TKR).

The analysis of artifacts extracted from the alluvial deposits (occurrences) are reported separately in this very section itself.

Sharda Temple-I (ST-I)

The sampled units of the site of ST-I have yielded as many as 52 artifacts while initially analysing into main groups i. e. (a) shaped tools, (b) modified artifacts, (c) unmodified waste, it was found that this first group formed the major component of the assemblage. It was represented by 37 tools forming 71.1% of the assemblage. The rest two groups are represented by 6:11.5% and 9:17.3%, respectively (Table 4 ; Fig. 52). The general physical condition of these artifacts show that they are only slightly abraded (52 : 100%; Table 5). It may, however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement through agencies other than water cannot be ruled out. But in the view of complete absence of water rolling evidence, it is difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint conditions. The patination is negligible because only a thin layer of patination is present on all artifacts.

Shaped tools (Table 4, 6, 7, 8 ; Fig. 53-56 ; Plate X-XII)

The various forms of shaped tools have been grouped into nine main tool classes. Out of main classes handaxes, cleavers, knives, broken-biface and scrapers are represented by 16.2, 32.4, 10.8, 8.1 and 21.6 percent, respectively and the remaining four classes i. e. pick, sub-spheroid, discoid, and bec by 2.7 percent each.

Handaxes (6 : 16.2% out of shaped tools). The primary forms of handaxes consist of side (2) and end (1) flakes, chunk (1) and indeterminates (2). On the basis of plan forms handaxes comprise three types : ovate (3 : 50%), limande (2 : 33.3%) and handaxe with untrimmed butt (1 : 16.7%). These tools are semi-invasive to invasive, bifacial to unifacial retouched. The number of scars is small on both the faces, though relatively more on the dorsal face. The presence of deep and shallow scars and irregular side edges suggest the use of hard and soft hammers.[1] Their cross-sections consist of biconvex (1), planoconvex-high back (2) and polygon (3). About 66.7% handaxes have 0-50% cortex and the rest have 50-100% cortex. The average length, width, thickness, width/length (W/L). thickness/width (T/W) and thickness/length (T/L) ratio is 12.8, 9.7, 5, 0.76, 0.51 and 0.38, respectively. The average edge angle of eleven sides is 79.3°.

One ovate and one untrimmed handaxes are technologically comparable with Bordes's partial handaxe and Abbevillian handaxe, respectively (Bordes, 1961; Plate 75:4 , 88 : 1,3).

Cleavers (12 : 32.4%). The primary forms of cleavers consist of side (4) and end (5) flakes, chunk (1) and indeterminates (2). These cleavers consist of parallel (5 : 41.6%), divergent (6 : 50%) and splayed (1 : 8.3%) types. The percentage of squared butt is more common (50%) than the rest two types—rounded and pointed. The later two butt types have 25% each. The oblique and convex bits have 4 frequencies each, while the frequency of straight and concave bits is 3 and 1, respectively. Number of deep and shallow scars is small on both the faces, though relatively more on dorsal face suggest use of both hard and soft hammers. These are semi-invasive, bifacial to unifacial retouched. These cleavers have six types of cross-sections trapezoid (6), planoconvex-low back (1), planoconvex-high back (1), triangular (1), parallelogram (2) and irregular quadrilateral (1). About 25% pieces have no cortex and the rest have 0-50% (5 : 41.6%) and 50-100% (4:33.3%). The average length, width, thickness, W/L, T/W and T/L is 12.9, 8.7, 4.3, 0.67, 0.50 and 0.33, respectively. The average edge angle of 24 sides is 91°.

Generally, cleavers made on flakes suggest the use of flake-cleaver technique.

Knives (4 : 10.8%). The knives comprise two types—side knives (3:75%) and end and-side knife (1 : 25%). The primary forms of knives consist of chunk (1) and indeterminates (3). The flat area on these knives, the distinct feature of knife, is either on the proximal end or middle of the right side. These are semi-invasive and bifacial retouched. Relatively more flake scars are on dorsal face than ventral face. The presence of both deep and shallow scars suggests the use of hard and soft hammers. The cross-sections of

knives consist of trapezoid (2:50%), biconvex (1:25%) and sub-triangular (1:25%). Three knives have 0-50% cortex and the rest one has no cortex. The average length, width, thickness, W/L, T/W and T/L is 12, 8.7, 4.2, 0.72, 0.48 and 0.35, respectively. The average edge angle of 4 sides is 93.2°.

Pick (1 : 2.7%). Its primary form is end flake and is convergent round ended pick. The number of scars on the dorsal face are relatively more than the ventral face. It is a semi-invasive, bifacial retouched pick. Shallow and deep scars suggest the use of soft as well as hard hammers. Its cross-section is planoconvex-low back and has no cortex. Its length, width and thickness is 16.3, 10.3 and 4.4, respectively.

Broken-bifaces (3 : 8.1%). All these specimens are the butt end fragments of bifaces. Most of the features are similar to bifaces. The primary forms of broken-bifaces consist of side flake (1) and chunks (2). These are invasive and bifacial retouched artifacts by hard and soft hammers. The cross-sections are lanticular, planoconvex-high back and planoconvex-low back. One each belongs to 50-100%, 0-50% and 0% cortex groups. Out of these three artifacts, it seems that atleast one is a fragment of handaxe (limande ?) and one is a fragment of cleaver (parallel ?). The available average length, width, thickness, W/L, T/W and T/L is 10.8, 8.4, 3.9, 0.77, 0.48 and 0.37, respectively. The average edge angle of 4 sides is 95.°

Sub-spheroid (1 : 2.7%). Its primary form is chunk and has 0-50% cortex. It is invasive, parti-bifacial retouched. Deep scars suggest the use of hard hammer. Its cross-section is polygon. The length, width and thickness is 12.3, 11.4 and 9.8, respectively.

Discoid (1 : 2.7%). Its primary form is indeterminate. It is semi-invasive parti-bifacial retouched discoid. The presence of deep scars suggest the use of hard hammer. It has a polygon cross-section and 50-100% cortex. The length, width and thickness is 12.7, 11.4 and 6, respectiely.

Scrapers (8 : 21.6%). The primary forms of scrapers consist of end (5) and side (2) flakes and chunk (1). This main class comprises four types of tools—single side scrapers (4:50%), double side scraper (1 : 12.5%), three side scrapers (2 : 25%) and end scraper (1 : 12.5%). Out of these eight scrapers one is broken. The forms of lateral edges of scrapers consist of straight (1), convex (6), and denticulate (1). Flake scrapers are generally normal retouched, except one inverse retouched scraper. The retouching is steep marginal and semi-invasive. The presence of deep and shallow scars again suggest the use of hard and soft hammers. The cross-section of these pieces comprises seven types—sub-triangular (2), biconvex (1), planoconvex-high back (1), planoconvex-low back (1), triangular (1), trapezoid (1) and parallelogram (1). About 50% scrapers have 50-100% cortex and the rest 37.5% and 12.5%

scrapers have 0% and 0·50% cortex, respectively. The average length, width, thickness, W/L, T/W and T/L is 10.9, 10, 4.2, 0.92, 0.44 and 0.39, respectively. The average edge angle of eleven sides is 89.8°. The average platform height and width is 2.8 and 6.5, respectively.

Bec (1:2.7%). Its primary form is chunk and has no cortex. It is a semi-invasive, alternate retouch specimen. The deep scars suggest the use of hard hammer. Its cross-section is planoconvex-low back. Its length, width and thickness is 9, 7.6 and 2.8, respectively.

Modified artifacts (Table 4,7 ; Fig. 52)

Only two types are present in this group. These are modified flakes and modified chunks.

Modified flakes (3 : 50% out of modified artifacts). These flakes have very minor modification on their edges and are end struck flakes. In plan form two are long quadrilateral and one elliptical. Their cross-section consist of—lanticular (1), triangular (1) and sub-triangular (1) types. About 66.3% specimens have no cortex and 33.3% have 50-100% cortex. The average length, width, thickness, W/L, T/W, T/L and flake angle is 11, 9, 3.3, 0.80, 0 37, 0.30 and 127°, respectively. All have plain striking platforms. The average height and width of striking platform is 2.9 and 5.4, respectively.

The prominent bulb and high flake angle reveal the use of hard hammer technique.

Modified chunks (3 : 50%). Like modified flakes, these pieces also have very minor modifications. Their cross-sections consist of trapezoid (2) and rhomboid (1). The average length, width, thickness, W/L, T/W and T/L is 13.1, 9.3, 5.1, 0.71, 0.54 and 0.39, respectively.

Unmodified waste (Table 4, 7, 9 ; Fig. 51, 55)

This group comprises flakes and bif ace-trimming flakes.

Flakes (8 : 88.9% out of unmodified waste). Out of eight, 5 are end flakes. Their plan forms consist of—short quadrilater al (1), long quadrilateral (2), short irregular (2) and long irregular (3). Their cross-sections are : 3—Sub-triangular, 2—trapezoid, 1—triangular, 1—planoconvex-high back, and 1—planoconvex-low back. About 62.5% have 50-100% cortex and the rest have 0-50% cortex. Three flakes have di-hedral striking platforms, while the rest five have plain striking platforms. The average height and width of platform is 3.6 and 7, respectively. The average length,

width, thickness, W/L, T/W, T/L and flake angle is 13, 9.5, 3.8, 0.74, 0.40, 0.29 and 119°, respectively.

The presence of prominent bulbs and high flake angle reveal the use of hard hammers.

Biface-trimming flakes (1 : 11.1%). This single specimen is short irregular side struck flake, having no cortex. The dorsal scar pattern suggest that it might have come out in course of biface trimming (Newcomer, 1971 ; Sinha, 1984, Appendix-B). The length, width and thickness is 5.8, 4.2 and 1.6, respectively. Its flake angle, height and width of platform is 115°, 1.7 and 3.7, respectively.

The presence of high flake angle and prominent bulb of percussion reveal that hard hammer was used.

Raw material and technique

All artifacts are fashioned on quartzite of various grain sizes and if without patination, purple in colour. But a thin layer of patination is present on all artifacts which has given a dirty yellow to dull brown colour to all artifacts. Generally, all artifacts would have been made by hard and soft hammers through direct percussion technique. Further, flakes were detached from boulders/cobbles or cores using convenient platform and with little or no previous preparation.

Sharda Temple-II (ST-II)

The sampled units of the site of ST-II have yielded as many as 62 artifacts. While initially analysing into main groups i. e. (a) shaped tools (b) modified artifacts and (c) unmodified waste, it was found that the first group formed the major component of the assemblage. It was represented by 50 tools forming 80.6% of the assemblage. The rest two groups are represented by 4 : 6.4% and 8:12.9%, respectively (Table 4; Fig. 57). The general physical condition of these artifacts show that they are fresh (40:64.5%) and slightly abraded (22:35.5%) (Table 5). It may, however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement through agencies other than water cannot be ruled out. But in view of complete absence of water rolling evidence it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition The patination is very thin

Shaped tools (Table 4, 6, 10, 11 ; Fig. 58-61 ; Plate XIII-XV)

The various forms of shaped tools have been grouped into seven main tool classes. Out of tool classes handaxes, cleavers, knives, picks, broken-bifaces, discoids and scrapers are represented by 28, 24, 6, 2, 2, 18 and 20 percent, respectively.

Handaxes (14 : 28% out of shaped tools). The primary forms consist of side (4) and end (2) flakes, chunks (2) and indeterminates (6). On the basis of plan forms, this class has seven tool types-ovate (5 : 35.7%), elongate ovate (1 : 7.1%), limande (3 : 21.4%), double pointed (1 : 7.1%), lanceolate (1 : 7.1%), sub-triangular (1 : 7.1%) and handaxes with untrimmed butt (2 : 14.3%). Relatively small number of scars are present on both the faces, like the ST-I, more on the dorsal face. These are semi-invasive to invasive, bifacial and unifacial retouched The presence of deep as well as shallow scars with irregular edges suggest the use of both hard and soft hammers. Two specimens have biconvex cross-section, and out of the rest twelve, four each have planoconvex-high back, sub-triangular and trapezoid cross-sections. The frequencies of handaxes in 50-100%, 0-50% and 0% cortex group is 1, 7 and 6, respectively. The average of length, width, thickness W/L, T/W and T/L is 11.2, 8.3, 4.1, 0.73, 0 50 and 0.36, respectively. The measured average edge angle of 26 sides is 80.4°.

Two ovate and two limande handaxes are relatively small, though very neatly made and show no sign of disintegration of these type of tools. Elongate ovate is slightly irregularly trimmed and have relatively unfinished butt end. Untrimmed butt handaxes and sub-triangular handaxe are comparable with the Bordes's Abbevillian handaxes.

Cleavers (12 : 24%). The primary forms consist of end (2) and side (2) flakes, chunks (3) and indeterminates (5). There are four types of cleavers—parallel (1:8.3%), divergent (2:16.7%), splayed (4:33.3%) and convergent (5:41.6%). The frequency of three types of butt—rounded, squared and pointed is 4, 5 and 3, respectively. The percentage of straight, oblique and convex bits is 41.7, 50 and 8.3, respectively. Relatively small number of scars are present on both the faces though more on dorsal face. Generally, these are semi-invasive to invasive, bifacial to parti-bifacial retouched. The presence of deep and shallow scars suggest the use of hard and soft hammers. These cleavers have six types of cross-sections—biconvex, planoconvex-high back, planoconvex-low back, triangular, trapezoid and irregular quadrilateral. Their frequencies are 3,2,1,2,3 and 1, respectively. About 66.7% have 0-50% cortex and the rest have no cortex. The average of length, width, thickness, W/L, T/W and T/L is 13.8, 8.8, 4.1, 0.64, 0.47 and 0.27, respectively. The measured average edge angle of 18 sides is 80.7°.

One convergent cleaver is relatively small, yet shows no sign of disintegration of this tool type, rather neatly made. The cleavers which are made on flakes generally suggest flake-cleaver technique.

Knives (3:6%). The two types of knives in this assemblage are side (1) and end and side (2). The primary forms consist of chunk and side flakes (2). Again relatively more scars are present on the dorsal face, though small number of scars on both the faces. The flat area is on the proximal right side. These are semi-invasive to invasive, bifacial to parti-bifacial retouched. The presence of deep and shallow scars suggest the use of both hard and soft hammers. This is also revealed from the side edges which are not straight rather irregular. These knives have two types of cross-sections—triangular (1) and sub-triangular (2). About 66.7% have 0-50% cortex and the rest 33.3% have 50-100% cortex. The average length, width, thickness, W/L, T/W and T/L is 12.4, 8, 4.3, 0.64, 0.54 and 0.34, respectively. The measured average edge angle of three sides is 79.3°.

Pick (1:2%). This is made on side struck flake and has been classified into convergent—round ended pick. It is a semi-invasive, bifacial retouched pick. Deep and shallow scars and irregular side edge suggest the use of both hard and soft hammers. Its cross-section is trapezoid and has 50-100% cortex. The length, width and thickness is 16.8, 11.7 and 5.0, respectively.

Broken-biface (1:2%). This is a butt end fragment of biface, made on indeterminate form. It bears all features of bifaces. Its cross-section is lanticular and has 0-50% cortex. Shallow and deep scars suggest the use of soft and hard hammers. The available length, width and thickness is 9.8, 11.6 and 5.5, respectively.

Discoids (9:18%). About 66.7%, 22.2% and 11.1% discoids are made on chunks, cobbles and end flakes, respectively. These discoids are semi-invasive to invasive, bifacial to parti-bifacial retouched. The presence of deep and shallow scars suggest the use of hard and soft hammer. These discoids have four types of cross-sections—biconvex (2), planoconvex-high back (1), rhomboid (1) and polygon (5). About 77.8% have 0-50% cortex and the rest have no cortex. The average length, width, thickness, W/L, T/W and T/L is 9.8, 8.8, 5.5, 0.89, 0.62 and 0.51, respectively. The measured average edge angle of twenty three sides is 86.5°.

Scrapers (10:20%). The primary forms of these scrapers are end flakes (5) and chunks (5). This main class comprises three types of tools—single side scrapers (5), end and side scrapers (4) and end scraper (1). Except one which is inverse retouched, rest all flake scrapers are normal retouched. The forms of lateral edges are straight (4), convex (3), denticulate (2) and straight convex (1). The retouching is steep, marginal as well as semi-invasive. The presence of both deep and shallow scars again suggests the employment of hard and soft hammers. The cross-section of these scrapers comprises planoconvex-high back (2), sub-triangular (1), trapezoid (3) and irregular quadrilateral (4). The frequency of 50-100%, 0-50% and 0% cortex is 3, 3 and 4, respectively. The average length, width, thickness, W/L, T/W and T/L is 11.6, 9.3, 4.5, 0.80, 0.48 and 0.39, respectively. The measured

average edge angle of fourteen sides is 85.7°. The average height and width of platform of flake-scrapers is 3.3 and 6 4, respectively.

Modified artifacts (Table 4, 10 ; Fig. 57)

There are two classes in this group, which comprises 50% modified flakes and 50% modified chunks.

Modified flakes (2 : 50% out of modified artifacts). These end flakes have very minor modification on their edges. In plan forms these two flakes are short quadrilateral and long quadrilateral. The cross-sections are sub-triangular and trapezoid. These two flakes have 50-100% and 0-50% cortex, respectively. The average length, width, thickness, W/L, T/W and T/L is 11.1. 8.3, 4.0, 0.74, 0.48 and 0.36, respectively. The average flake angle, height and width of platform is 119°, 3.6 and 7.3, respectively. The presence of prominent bulbs and high flake angle suggests the use of hard hammer.

Modified chunks. (2 : 50%). Like modified flakes these pieces also have minor modification on their edges. These pieces have trapezoid and planoconvex-high back cross-sections. The average length, width, thickness, W/L, T/W and T/L is 7.9, 5.6, 2.4, 0.7, 0.43 and 0 30, respectively.

Unmodified waste (Table 4, 9, 10 ; Fig. 57, 61 ; Plate XV)

This group consists of flakes, biface-trimming flakes and cores.

Flakes (4 : 50% out of unmodified waste). All, except one side struck flake, are end struck flakes. Their plan forms are long quadrilateral (2) long triangular (1) and long irregular (1). Each flake has different cross-section : planoconvex-low back, triangular, sub-triangular and trapezoid. About 75% have 0-50% cortex and the rest have 50-100% cortex. The average length, width, thickness, W/L, T/W, T/L and flake angle is 12.8, 10.7, 3.7, 0.81, 0.38, 0 29 and 118°, respectively. All have plain striking platfrom. The average height and width of platform is 3.2 and 5.9, respectively. Again the presence of prominent bulbs and high flake angle suggests the use of hard hammer.

Biface-trimming flakes (2 : 25%). These are side struck flakes, having sub-triangular cross-section. As in the case of ST-I, here too attributes suggest that these are biface trimming flakes. There is no cortex on one specimen, while the another has 0-50% cortex. The average length, width, thickness, W/L, T/W, T/L and flake angle is 5.9, 4.6, 1.9, 0.77, 0.42, 0.33 and 115°, respectively. The average height and width of platform is 1.6 and 3.4, respectively.

Cores (2:25%). These are flake cores having long quadrilateral plan form and have scar pattern of one direction—irregular direction. The cross-sections are triangular and sub-triangular. One flake core has 0-50%

cortex while the other has no cortex. The average of flake angle, length, width, thickness, W/L, T/W and T/L is 115°, 16.3, 14.1, 6.3, 0.86, 0.44, and 0.38, respectively.

The prominent positive and negative bulbs suggest the use of hard hammer.

Raw material and technique

All artifacts are fashioned on quartzite of various grain sizes and if, without patination than purple in colour. But a thin coat of patination is present on all artifacts, which has given dirty yellow to dull brown colour to all artifacts. Generally all artifacts would have been made by hard and soft hammers through direct percussion technique. Further, flakes were removed from cores or boulders/cobbles using convenient platform and with little or no previous preparation.

Sharda Temple-III (ST-III)

The sampled units of the site of ST-III have yielded as many as fifty five artifacts, while at the initial analysis stage, it was found that shaped tools formed the major component of the assemblage. It was represented by 33 tools forming 60% of the assemblage. The rest two groups—modified artifacts and unmodified waste are represented by 5 : 9% and 17 : 30.9%, respectively (Table 4; Fig. 62). The general physical condition of these artifacts show that they are fresh (2 : 3 6%) and slightly abraded (49 : 89.1%), though a few heavily abraded artifacts (4 : 7.3%) are also present (Table 5). It may, however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement, through agencies other than water can not be ruled out But in view of complete absence of water rolling evidence, it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition. The patination is very thin.

Shaped tools (Table 4, 6, 12, 13; Fig. 63-66; Plate XVI-XVIII)

The various forms of shaped tools have been grouped into seven main tool classes. Out of main tool classes chopper, handaxes, cleavers, knives, broken-biface, discoids and scrapers are represented by 3, 36.4, 30.3, 12.1, 3, 3 and 12.1 percent, respectively.

Chopper (1 : 3% out of shaped tools). This is an end parti-bifacial chopper made on cobble (pebble). It's cross-section is sub-triangular. Deep scars suggest the use of hard hammer. About 50-100% cortex is present. The length, width and thickness is 12.8, 10.3 and 7.3, respectively.

Handaxes (12 : 36.4%). The primary forms consist of side (1) and end (2) flakes, chunks (3), cobble (1) and indeterminates (5). On the basis of plan forms this class has six types of handaxes—ovate (3 : 25%), ovate accuminate (1 : 8.3%), limande (1 : 8.3%), sub-triangular (2 : 16.7%), cordiform (2 : 16.7%) and handaxes with the untrimmed butt (3 : 25%). Like ST-I and ST-II relatively small number of flake scars are present on both the faces and more on the dorsal face. These handaxes are semi-invasive to invasive, bifacial to partibifacial retouched. The presence of deep as well as shallow scars with irregular edges suggest the use of both hard and soft hammers. These handaxes have six types of cross-sections—biconvex (5), planoconvex-high back (2), planoconvex-low back (1), sub-triangular (1), trapezoid (1) and polygon (2). The frequency of handaxes in 50-100%, 0-50% and 0% cortex groups is 2, 7 and 3, respectively. The average length, width, thickness, W/L, T/W and T/L is 11.6, 8.4, 4.8, 0.73, 0.57 and 0.42, respectively. The measured average edge angle of 24 sides is 90.9°.

One ovate and one limande handaxes are relatively small, but very neatly made and show no sign of disintegration of these type of tools. Though, these are smaller than those mentioned in ST-II. One cordiform handaxe has relatively unfinished butt while the other cordiform handaxe is comparable with the Bordes's partially handaxe.

Cleavers (10 : 30.3%). The primary forms of cleavers consist of end flakes (5), chunks (2) and indeterminates (3). This class consist of four types of cleavers—parallel (4 : 40%) divergent (1 : 10%), splayed (3 : 30%) and convergent (2 : 20%). The butt types of cleavers consist of—rounded (1 : 10%), squared (6 : 60%) and pointed (3 : 30%). The percentage of convex bits is 40% and the rest two types of bits—straight and oblique have 30% each. Like bifaces of other sites here too, small number of scars are present on both the faces and relatively more on dorsal face. These cleavers are marginal to invasive, bifacial to unifacial retouched. The presence of deep and shallow scars suggest the use of hard and soft hammers. These cleavers have various types of cross-sections like biconvex (1), planoconvex—high back (1), subtriangular (2) and trapezoid (6). About 50% have 50-100% cortex and the rest 30% and 20% cleavers have 0-50% cortex and 0% cortex, respectively. The average length, width, thickness, W/L, T/W and T/L is 12.1, 8.1, 4.0, 0.67, 0.49 and 0.33, respectively. The average edge angle of 18 sides is 94.2°.

Generally, cleavers made on flakes suggest flake-cleaver technique. One splayed cleaver is relatively small, but shows no sign of disintegration, rather finely made.

Knives (4 : 12.1%). All are side knives and their primary forms consist of side (2) and end (1) flakes and chunk (1). Almost equal number of scars are present on both the faces. Like the ST-I and ST-II, here also flat area is

present on the middle of the right side. These are marginal, bifacial to parti-bifacial retouched artifacts. The presence of deep and shallow scars and irregular edges suggest the use of hard and soft hammers. There are three types of cross-sections : sub-triangular (2), trapezoid (1) and irregular quadrilateral (1). Two knives have 50-100% cortex, while the other two have 0-50% and 0% cortex, respectively. The average length, width, thickness, W/L, T/W, and T/L is 14.2, 9.6, 4.3, 0.67, 0.46 and 0.30, respectively. The measured average edge angle of 4 sides is 94.2°.

Broken-biface (1 : 3%). This is a butt end fragment of a biface, made on side flake. It bears all features of bifaces. Its cross-section is irregular quadrilateral and has 50-100% cortex. It seems to be a fragment of a cleaver (divergent ?). Shallow and deep scars suggest the employment of hard and soft hammers. The available length, width and thickness is 10.2, 8.5, and 4, respectively.

Discoid (1 : 3%). This specimen has 0-50% cortex and polygon cross-section. It is made on cobble. This is a marginal, parti-bifacial retouched discoid. The presence of deep scars and irregular edge suggest the use of hard hammer. Its length, width and thickness is 9.5, 9 and 5.9, respectively.

Scrapers (4 : 12.1%). The primary forms of scrapers consist of side (3) and end (1) flakes. This class comprises three single side scrapers and one circular scraper. The forms of lateral edges are straight (3) and convex (1). Out of four scrapers, two are steep marginal and normal retouched and two are steep marginal inverse retouched. Generally, deep scars are present which suggest the use of hard hammer. The cross-sections of these scrapers comprise three trapezoid and one biconvex. Only one scraper has 0-50% cortex, and the rest three have no cortex. The average length, width, thickness, W/L, T/W and T/L is 8.8, 6.6, 3.0, 0.75, 0.44 and 0.33, respectively. The measured average edge angle of 6 sides is 87.5°.

Modified artifacts (Table 4, 12; Fig. 62)

There are two types in this group, which consist of 80% modified flakes and 20% modified chunks.

Modified flakes (4 : 80% out of modified artifacts). All are short quadrilateral end struck flakes having 0-50% cortex. Each has different cross-section—triangular, sub-triangular, trapezoid and irregular quadrilateral. The average length, width, thickness, W/L, T/W and T/L is 9.4, 7.9, 3.6, 0.84, 0.45 and 0.38, respectively. The average flake angle, height and width of striking platform is 113°, 2.8 and 5.5, respectively.

The presence of prominent bulb and high flake angles suggests the use of hard hammer.

Modified chunk (1 : 20%). Its cross-section is irregular quadrilateral. The length, width and thickness is 10, 7.6 and 3.5, respectively.

Unmodified waste (Table 4, 9, 12 ; Fig. 62, 66)

This group consists of flakes (10), flake fragments—proximal (4) and cores (3).

Flakes (10 : 58.8% out of unmodified waste). Out of ten flakes 4 are side flakes. The plan forms of flakes consist short quadrilateral (4), long quadrilateral (1), short-irregular (2), long-irregular (1) and elliptical (2). These flakes vary in cross-sections—bicovex (1) planoconvex-high back (1), planoconvex—low back (1). triangular (2) sub-triangular (4) and trapezoid (1). The frequency of flakes in 50-100%, 0-50% and 0% cortex group is 6, 2 and 2, respectively. The average length, width, thickness, W/L, T/W and T/L is 10.4, 8.6, 4.1, 0.83, 0.47 and 0.39, respectively. The average flake angle, height and width of striking platform, including four proximal flake fragments is 115°, 3.0 and 5.7, respectively. The high flake angle and prominent bulbs of percussion suggest the use of hard hammer.

Flake fragments (*proximal*) (4 : 23.5%). These are one side and three end struck flake fragments. Due to the fact that more than 2/3 length is present their plan form and cross-section can be inferred The planforms consist of short quadrilateral (2) and long quadrilateral (2). Their cross-sections are planocovex-high back, sub-triangular, trapezoid and rhomboid. The measurements of flake angle and height and width of platforms have been included in the analysis of flakes.

Cores (3 : 17.6%). These are flake cores having two types of scar patterns-one directional irregular (1) and two directional opposed. Their cross-sections are triangular, sub triangular and irregular quadrilateral. About 66.7% cores have 0-50% cortex while the rest have no cortex. The average length, width and thickness, W/L, T/W and T/L is 15.2, 9.9, 6, 0.64, 0.60 and 0.39, respectively. The prominent positive and negative bulbs of percussions suggest the use of hard hammer technique.

Raw material and technique

All the artifacts of this assemblage like the ST-I and ST-II are fashioned on quartzite of various grain sizes and if without patination, then purple in colour. But a thin coat of patination is present on all artifacts which has given a dirty yellow to dull brown colour to all artifacts. Generally, all artifacts would have been made by hard and soft hammers through direct percussion technique. Moreover, flakes were detached from cores or boulders/cobbles using convenient platform and with little or no previous preparation.

Sharda Temple-IV (ST-IV)

The sampled units of the site of ST-IV have yielded as many as 67 artifacts, while at the initial stage of analysis, it was found that shaped tools formed the major component of the assemblage, though unmodified waste group is close to it. Shaped tools and unmodified waste are represented by 33 : 49.2% and 26 : 38 8%, respectively. While the third group modified artifacts has 8:11.9% (Table 4, Fig. 67). The general physical condition of these artifacts show that they are mainly fresh (21:31. 3%) and slightly abraded (41 : 61.2%) though moderately (2 : 3%) and heavily abraded artifacts (3:4.5%) are also present (Table 5). It may however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement through agencies other than water cannot be ruled out, but in view of complete absence of the evidence of water rolling, it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition. The patination is very thin.

Shaped tools (Table 4, 6, 14, 15 ; Fig. 68-71 ; Plate XIX-XXI)

The various forms of shaped tools have been grouped into seven main tool classes. Out of main tool classes proto-handaxe, handaxes, cleavers, broken-biface, sub-spheroid, scrapers and bec are represented by 3, 12.1, 39.4, 24.2, 3, 15.1 and 3 percent, respectively.

Proto handaxe (1:3% out of shaped tools). This is made on end flake having 50-100% cortex. Its cross section is planoconvex-high back. It is a normal, marginal retouched specimen. The presence of quite deep scars suggest the use of hard hammer. The flake angle is 130°, height and width of plain striking platform is 2.3 and 5.7, respectively. The length, width and thickness is 13.2, 12.3 and 5.3, respectively.

Handaxes (4:12.1%). The primary forms of handaxes consist of chunk (1) and indeterminates (3). On the basis of plan form this class has only two types—ovate (3:75%) and limande (1:25%). These are semi-invasive to invasive and bifacial retouched. The presence of deep and shallow scars with irregular edges reveal the use of both hammers i.e. hard and soft. These handaxes comprise of two types of cross-sections—biconvex (2) and polygon (2). About 50% hand handaxes have 0-50% cortex while the rest two have 50-100% and 0% cortex, respectively. The average length, width, thickness, W/L, T/W and T/L is 13.7, 10.5 5.8, 0.77, 0.57 and 0.43,respectively. The measured average edge angle of six sides is 74.7°.

Cleavers (13:39.4%). The primary forms of cleavers consist of end (10) and side (2) flakes and indeterminate (1). There are three types of cleavers-parallel (6), divergent (9) and convergent (2) in this assemblage. Rounded,

squared and pointed butt forms of these cleavers have 2, 5 and 6 specimens, respectively. The frequency of straight, oblique and convex bits is 2, 8 and 3, respectively. The presence of deep and shallow scars, relatively more on dorsal face, suggest the use of two types of fabricators—hard and soft hammers. These cleavers are marginal to semi-invasive and bifacial to unifacial retouched. The cross-section of these cleavers consists of- biconvex (1), lanticular (1), planoconvex—high back (1) planoocnvex—low back (1), sub-triangular (2) trapezoid (4) and parallelogram (3). About 69.2% cleavers have no cortex, while the rest have 0-50% cortex. The average length, width, thickness, W/L, T/W and T/L is 14.7, 9.5, 5.0, 0 65, 0.53 and 0.33, respectively. The measured average edge angle of 26 sides is 93.3°. Those cleavers made on flakes, frequently suggest theuse of flake-cleaver technique.

Broken-bifaces (8:24.2%). These are butt end (4) and tip end (4) fragments of bifaces and have all features of bifaces. The primary forms of broken-bifaces consists of side (2) and end (1) flakes, chunk (1) and indeterminates (4). Except one cleaver which has 50-100% cortex, rest have no cortex. These broken-biface comprise five types of cross-sections—plano-convex-high back (3), planoconvex-low back (2). sub-triangular (1), trapezoid (1) and irregular quadrilateral (1). All evidences support the use of hard and soft hammers. The available average length, width, thickness, W/L, T/W and T/L is 10.8, 9.5, 4.3, 0.91, 0 45 and 0 41, respectively. The measured average edge angle of nine sides is 96.8°. It appears in these four specimens that atleast two belong to knife and one each to handaxe and cleaver.

Sub-spheroid (1:3%). Its primary form is chunk and has 0-50% cortex. It is an invasive and parti-bifacial retouched piece. Deep scars suggest the use of hard hammer. Its cross-section is polygon. The length, width and thickness is 9.8, 8.2 and 7.4, respectively.

Scrapers (5 : 15.1%). The primary forms of scrapers consist of end flakes (3) core (1) and indeterminate (1). These scrapers comprise four types—single side (2), double side (1), three sides (1) and core scraper (1). The forms of lateral edges of these scrapers are straight (1), convex (2), concave-denticulate (1) and straight-concave (1). Except one which is inverse retouched, rest are normal and semi-invasive retouched. Generally, deep scars are present, which suggest the use of hard fabricator. Four scrapers have trapezoid cross-section, while the remaining one has rhomboid. The frequency of 50-100%, 0-50% and 0% cortex groups is 1, 2 and 2, respectively. The average length, width, thickness, W/L, T/W and T/L is 10.3, 8.3, 4.7, 0.82, 0.55 and 0 43, respectively. The measured average edge angle of ten sides is 83.9°. The average flake angle, height and width of striking platform is 119°, 2 8 and 4.6, respectively.

The scraper on core strictly cannot be classified into separate core-scraper class. Only two small irregular negative scars are present, which suggest that couple of flakes would have been removed from its primary chunk form. Moreover, the side of core and the absence of platform reveal, that these couple flake scars are either accidental or might be, the maker was planning to make spheroid or discoid, but later changed his/her mind and steeply retouched its edge. It is, therefore, technically called core scraper and is included in the main class of scrapers.

Bec (1 : 3%). Its primary form is chunk and has 0-50% cortex. It is an alternate and semi-invasive retouched specimen. Deep scars suggest the use of hard hammer. Its cross-section is irregular quadrilateral. The length, width and thickness is 18, 12 and 4.7, respectively.

Modified artifacts (Table 4, 14; Fig. 67)

Only one type i. e., modified flake, is present in this group.

Modified flakes (8 : 100%). Out of eight three are side and rest five are end flakes. These flakes vary in their plan forms. Their plan forms consist short-quadrilateral (1), long-quadrilateral (1), long-triangular (2), short-irregular (1), long irregular (2) and elliptical (1). Their cross sections are biconvex (7), planoconvex-low back (1) sub-triangular (1), rhomboid (2) and parallelogram (3). Equal frequency of these modified flakes is present in the two groups of cortex—50-100% and 0-50% cortex. The average length, width, thickness, W/L, T/W and T/L is 11.6, 9.0, 4.3, 0.37, 0.48 and 0.37, respectively. The average flake angle, height and width of striking platform is 117°, 2.9 and 4.7, respectively.

The presence of prominent bulb and high flake angle suggest the use of hard hammer.

Unmodified waste (Table 4, 9, 14 ; Fig. 67, 71 ; Plate XXI)

This group comprises flakes (18 : 69.2%), flake fragments (proximal) (3 : 11.5%) and biface-trimming flakes (5 : 19.2%).

Flakes (18 : 69.2% out of unmodified waste). These are side (5) and end (13) flakes. The plan forms of flakes consist of short quadrilateral (2), long quadrilateral (2), short-triangular (3), long-triangular (1), short-irregular (3) long-irregular (4) and elliptical (3). The cross-section of flakes comprise-biconvex (2), planocovex-high back (1), Planconvex-lowback (1), triangular (3), sub-triangular (7), trapezoid (3) and irregular quadrilateral (1). The frequency in 100%, 50-100%, 0-50% and 0% cortex group is 1, 9, 5 and 3, respectively. The average length, width, thickness, W/L, T/W and T/L is 11.8, 10.2, 4, 0.89, 0.40 and 0.34, respectively. All flakes have plain striking platforms. Including

proximal flake fragments the average flake angle, height and width of platforms is 117°, 4.1 and 6, respectively.

The presence of prominent bulbs and high flake angles suggests that hard hammers would have been used.

Flake fragments (proximal) (3 : 11.5%). These are end flakes, having triangular cross-sections. Because of the fact that more than 2/3 of length is available the inference about their plan forms and cross section is made. In plan form they are short-quadrilateral, long-quadrilateral and long-irregular. They have 50-100% (2) and 0-50% cortex (1). The measurements of flake angle and height and width of platforms of two flake fragments have been included in the flakes above. The remaning flake is slightly broken at the platform.

Biface-trimming flakes (5 : 19.2%). These are side (3) and end struck (2) flakes, having planoconvex-low back (2), triangular (1) and trapezoid (2) cross-sections. No cortex is present on either four specimens and 0-50% cortex is present on one specimen. In plan forms they are short quadrilateral (2), short irregular (2) and long irregular (1). The type of scar pattern consist of one directional irregular (2) and convergent (3). The average length, width, thickness, W/L, T/W and T/L is 7, 5.7, 2.4, 0.81, 0.41 and 0.34, respectively. The average flake angle, height and width of platform is 109°, 1.19 and 3.5, respectively.

Raw material and technique

All artifacts are fashioned on quartzite of various grain sizes and if without patination, purple in colour. But a thin covering of patination has given a dirty yellow to dull brown colour to all artifacts. Generally, all artifacts would have been made by hard and soft hammers through direct percussion technique. Further flakes were struck from boulders/cobbles or cores using convenient platform and with little or no previous preparation.

Naru Hill (NRH)

The sampled units of the site of NRH have yielded as many as 39 artifacts, while initially analysing into main groups, it was found that shaped tools formed the major component of the assemblage, though unmodified waste group is close to it. Shaped tools and unmodified waste are represented by 16 : 41% and 14 : 35.9%, respectively. While the third group modified artifacts has 9 : 23% (Table 4; Fig. 72). The general physical condition of these artifacts shows that they are mainly slightly abraded (27 : 69.2%), though moderately (9 : 23.1%) and heavily abraded (3 : 7.7%) are also present (Table 5). It may,

however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement through agencies other than water can not be ruled out. But in view of complete absence of the evidence of water rolling, it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition. The patination is very thin.

Shaped tools (Table 4, 6, 16, 17; Fig. 73-75 ; Plate XXII—XXIII)

The various forms of shaped tools have been grouped into four main tool-classes. Out of main tool classes handaxes, cleavers, knife and scrapers are represented by 37.5, 37.5, 6.2 and 18.7 percent, respectively.

Handaxes (6 : 37.5% out of shaped tools). The primary forms of handaxes consist of end flakes (3) and chunks (3). On the basis of plan forms the type of these handaxes are ovate (2), sub-triangular (1) and untrimmed butt (3). Most of the handaxes are unfinished and it seems that a few of them would have been, perhaps, discarded. Moreover, deep scars are more than shallow scars that obviously suggest that they are not well made rather handaxes are in between first and second stages of handaxe manufacturing process (Newcomer, 1971). The cross-sections of these handaxes are—biconvex (1), planoconvex-high back (2), planoconvex-lowback (1), rhomboid (1) and polygon (1). These handaxes are equally divisible into two cortex groups—50-100% and 0-50% cortex. The average length, width, thickness, W/L, T/W and T/L is 12.7, 9.9, 5.3, 0.77, 0.56 and 0.44, respectively. The measured average edge angle of nine sides is 87.8°.

Cleavers (6 : 37.5%). The primary forms of cleavers consist of side flakes (2), chunks (2) and indeterminates (2). This class consists of four types of tools parallel (3), divergent (1), splayed (1) and convergent (1). These cleavers comprise three types of butt forms rounded (2), squared (3) and pointed (1), while the bit types are : straight (3), oblique (2) and convex (1). As in the case of handaxes, these are also partially finished. Like handaxes cleavers also vary in degree of retouch nature and classes. It ranges from unifacial to bifacial and marginal to invasive. Here too, the use of hard hammer is more than the soft hammer. All cleavers have trapezoid cross-section. These cleavers are equally divisible into two cortex groups—50-100% and 0-50% cortex. The average length, width, thickness, W/L, T/W and T/L is 11.8, 8.3, 4.4, 0.71, 0.54 and 0.38, respectively. The measured average edge angle of seven sides is 98.4°. One parallel cleaver is relatively small.

Knife (1 : 6.2%). Its primary form is chunk and has trapezoid cross-section. The flat area is on the right side and is classified into side knife. It has 0-50% cortex and marginal, bifacial retouched. The presence of shallow

and deep scars suggest the use of soft as well as hard hammer. Its length, width, thickness and edge angle is 12.5, 9.3, 3.8 and 82° respectively.

Scrapers (3 : 18.7%). The primary form of scrapers is end flakes, though two are slightly broken. These scrapers comprise two types—single side (2) and double side (1). The lateral edge form of scrapers consists of denticulate (1), straight-straight (1) and straight-concave (1). Their cross-sections are sub-triangular (2) and trapezoid (1). They are marginal, normal or alternately retouched. The presence of relatively more deep scars suggests the use of hard hammer. These three scrapers fall into three groups of cortex—50-100%, 0-50% and 0% cortex. The length, width, thickness and flake angle is 16.2, 10.3, 4.4 and 120° respectively. The single measurable scraper has plain striking platform with 3.6 height and 8.8 width.

Modified artifacts (Table 4, 16; Fig. 72)

Modified flake and modified chunks (8) constitute this group.

Modified flake (1 : 11.1% out of modified artifacts). It is an end flake having planoconvex-high back cross-section. It retains 50-100% cortex. It is short irregular in plan form. The length, width, thickness and flake angle is 13.4, 12, 6 5 and 130° respectively. It has plain striking platform with 3.6 and 8.6 height and width, respectively.

Modified chunks (8 : 88.8%). The cross-section of modified chunks consists of biconvex (2), sub-triangular (2), trapezoid (1) and polygon (3). Two or three deep flake scars are present on each piece. Probably, these specimens are in the first stage of handaxe manufacturing. The average length, width, thickness, W/L, T/W and T/L ratio is 11.6, 9.1, 5.1, 0.79, 0.54 and 0.42, respectively.

Unmodified waste (Table 4, 9, 16; Fig. 72, 75 ; Plate XXIII-XXIV)

Flakes (11), flake fragments (proximal) (2) and core (1) are three classes in this group.

Flakes (11 : 78.6% out of unmodified waste). These are six side and five end flakes. The plan forms of flakes consist of short quadrilateral (1), long quadrilateral (2), short triangular (2), long triangular (1), short irregular (1), long irregular (3) and elliptical (1). The cross-sections of these flakes are—triangular (3), sub-triangular (4), trapezoid (3) and irregular quadrilateral (1). One flake has 100% cortex and out of the rest ten, 5 each have 50-100% and 0-50%, respectively. The average length, width, thickness, W/L, T/W and T/L is 12, 11.3, 4.3, 0.96, 0.39 and 0.35, respectively. Including one (proximal) flake fragment, the average flake angle and height and width of all plain striking platform is 108°, 3 and 7.3, respectively.

The presence of prominent bulb of percussion and high flake angle suggest hard hammer technique.

Flake fragments (proximal) (2 : 14.3%). These two fragments are side flakes. One is broken at the platform and another at the distal end, but about 2/3 portion is present which suggests planoconvex-low back and trapezoid cross-sections. Long quadrilateral and elliptical are their plan forms.

Core (1 : 7.1%). This is a flake core on side flake. Its cross-section, plan form and scar pattern is planoconvex-high back, long irregular and one direction-irregular, respectively. Its flake angle, and height and width of plain striking platform is 135°, 3.0 and 7.2, respectively. It has 0-50% cortex and its length, width and thickness is 11, 11.6 and 6, respectively.

Raw material and technique

All artifacts are fashioned on quartzite of various grain sizes and if without patination, purple in colour. But a thin layer of patination is present on all artifacts which has given a dirty yellow to dull brown colour to all artifacts. The use of hard hammer is relatively more than soft hammer in course of direct percussion technique. Further, flakes were detached from cores or boulders/cobbles using convenient platform and with little or no previous preparation.

Belhata-II (BHT-II)

The sampled units of the site of BHT-II have yielded as many as twenty artifacts, while at the initial stage of analysis, it was found that shaped tools formed the major component of the assemblage. It was represented by 12 tools forming 60% of the assemblage. The rest two groups—modified artifacts and unmodified waste are represented by 5:25% and 3:15%, respectively (Table 4; Fig. 76). The general physical condition of these artifacts show that they are mainly fresh (2:10%) and slightly abraded (12:60%), though moderate (5:25%) and heavily abraded (1:5%) artifacts are also present (Table 5). It may, however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement through agencies other than water cannot be ruled out. But in view of complete absence of the evidence of water rolling, it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition. The patination is very thin.

Shaped tools (Table 4, 6, 18, 19 ; Fig. 77, 78 ; Plate XXV)

The various forms of shaped tools have been grouped into four main tool

classes. Out of main tools classes handaxes, cleavers, broken-biface and scrapers are represented by 8.3, 41.7, 25 and 25 percent, respectively.

Handaxe (1:8.3% out of shaped tools). This sub-triangular handaxe is made on chunk, having sub-triangular cross-section. About 0-50% cortex is present. It is a unifacial, marginal retouched handaxe. The presence of shallow and a few deep scars suggest the use of soft and hard hammers. The average of (two sides) edge angle is 79.5°. The length, width, and thickness is 13.5, 9.2 and 4.5, respectively. It is comparable with Bordes's partial handaxe.

Cleavers (5:41.7%). The primary forms of cleavers consist of end (1) and side (1) flakes and indeterminates (3). These are three types of cleavers—parallel (3), divergent (1), and convergent (1). All cleavers have squared butt and straight bit. These are marginal, bifacial retouched. Both, deep and shallow scars are present suggesting thereby the use of hard and soft hammers. Four cleavers have planoconvex-high back cross-sections and one has parallelogram cross-section. All cleavers have 0-50%cortex. The average length, width, thickness,W/L, T/W and T/L is 13 6, 9.3, 4.8, 0.69, 0.50, and 0.35, respectively. The average edge angle of 9 sides is 91.9°.

Cleavers on flakes clearly suggest the employment of flake-cleaver technique.

Broken-biface (3:25%). The primary form of broken-biface consists of chunk (1), side (1) and end (1) flakes. These are butt end fragments of bifaces. Two pieces have 0-50% cortex while the third has 50-100% cortex. Two pieces appear to be fragments of cleavers (divergent and convergent ?) and one of side knife. They are marginal, parti-bifacial (2) and bifacial retouched (1). Their cross-sections consist of lanticular (1), trapezoid (1) and parallelogram (1). All evidences suggest the use of hard and soft hammers. The available length, width, thickness, W/L, T/W and T/L is 10.4, 8.5, 4.5, 0.81, 0.53 and 0.43, respectively.

Scrapers (3:25%). These scrapers comprise two types—single side scrapers (2) and angled scraper (1). One single side scraper made on end flake (primary form) is broken. Rest two are on chunks. Their lateral edge form consists of straight, straight-straight and denticulate. Retouching is marginal, steep and normal. The presence of deep scars suggests the use of hard hammer. The cross-section of scrapers consist of sub-triangular (2) and trapezoid (1). All scrapers have 0-50% remains of cortex. The average length, width, thickness, W/L, T/W and T/L is 9.2, 8.3, 4.0, 0.9, 0.47 and 0.42, respectively. The average edge angle of four sides is 95.2°.

Modified artifacts (Table 4, 18 ; Fig. 76)

This group comprises modified flake (1) and modified chunks (4).

Modified flake (1:20% out of modified artifacts). This is an end flake, having 50-100% cortex and long quadrilateral plan form. Its cross-section is sub-triangular. The length, width, thickness and flake angles is 8.3, 5.7 3.6 and 120°, respectively. The height and width of plain striking platform is 1.8 and 4, respectively.

Modified chunks (4:80%). These specimens have three types of cross-sections planoconvex-high back (1), trapezoid (2) and polygon (1). Out of four, two are recently broken. The average of two modified chunks for length, width, thickness, W/L, T/W and T/L is 9.6, 7, 4.2, 0.73, 0.59 and 0.43, respectively.

Unmodified waste (Table 4, 9, 18 ; Fig. 76 ; Plate XXV)

Flakes, flake fragments (proximal) are two classes of this group.

Flakes (2 : 66 7% out unmodified waste). Both flakes are end struck and have long quadrilateral plan form. These flakes have trapezoid cross-sections and 0-50% and 50-100% remains of cortex. The average length, width, thickness, W/L, T/W and T/L is 12.2, 7.8, 3.8, 0.64, 0.48 and 0.31, respectively. The average flake angle, height and width of plain platforms is 116°, 2.2 and 5.5, respectively.

The presence of prominent bulb and high flake angle suggests the use of hard hammer.

Flake fragment (proximal) (1:33.3%). This is an elliptical end flake fragment, having 50-100% cortex. Its cross-section is biconvex.

Raw material and technique

All artifacts are fashioned on quartzite of different grain sizes and if without patination, purple in colour. But a thin coat of patination is present on all artifacts which has given dirty yellow to dull brown colour to these artifacts. Generally, hard and soft fabricators would have been used for direct percussion technique. Further, flakes were struck from cores or boulders/cobbles using convenient platform and with little or no previous preparation.

Sagatha (SGT)

The sampled units of the site of SGT have yielded as many as seventeen artifacts, while at the initial stage of analysis, it was found that shaped tools formed the major component of the assemblage. It was represented by 10 tools forming 58.8% of the assemblage. The rest two groups—modified artifacts and unmodified waste are represented by 3 : 17.6% and 4 : 23.5%, respectively (Table 4; Fig. 79). The general physical condition of artifacts show that they are mainly slightly abraded (10 : 58.8%), though moderate (5 : 29.4%) and heavily abraded (2 : 11.8%) are also present (Table 5). It may, however, be pointed out that they do not bear any sign of water rolling. Though in

the absence of adequate soil cover the possibility of their minor displacement through agencies other than water cannot be ruled out, but in view of complete absence of the evidence of water rolling, it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition. The patination is very thin.

Shaped tools (Table 4, 6, 20, 21 ; Fig. 80, 81 ; Plate XXVI)

The various forms of shaped tools have been grouped into four main tool classes. Out of main tool classes handaxe, cleavers, broken-biface and scrapers are represented by 10, 50, 10 and 30 percent, respectively.

Handaxe (1 : 10% out of shaped tools). This is a limande handaxe on indeterminate primary form having planoconvex-low back cross-section. About 0-50% cortex is present. It is a semi-invasive, unifacial retouched handaxe. Shallow and deep scars suggest the use of soft and hard hammers. The length, width and thickness is 14.5, 10.5 and 4.5, respectively.

Cleavers (5 : 50%). The primary form of cleavers consists of end flake (1), chunks (2) and indeterminates (2). This class comprises four types of cleavers-parallel (1), divergent (1) splayed (1) and convergent (2). Most of the cleavers have squared butts (4) though one has rounded butt, and the frequency of straight, oblique and convex bits is 1, 2 and 2, respectively. These cleavers have semi-invasive, bifacial or parti-bifacial retouching. Deep and shallow types of scars are present which suggest the use of hard and soft hammers. Their cross-section consists of biconvex (1), planoconvex high back (1), trapezoid (1) and irregular quadrilateral (2) All have about 50-100% cortex. The average length, width, thickness, W/L, T/W and T/L is 12.8, 9.4, 4.5, 0.73, 0.48 and 0.35, respectively. The average edge angle of eight sides is 87.6°.

Broken-biface (1 : 10%). It is a tip end fragment of biface, very likely of handaxe. It is made on chunk and has semi-invasive, bifacial retouching. Hard and soft, both hammers were used as fabricator. Its cross-section is planoconvex-low back. 50-100% cortex is present on the dorsal face. The available length, width and thickness is 7.3, 8.2, and 2.7, respectively.

Scrapers (3:30%). All are single side scrapers on chunk, core and cobble. The lateral edge forms of these scrapers consist of straight (2) and convex (1) forms. These are semi-invasive, normal or inverse retouched scrapers. Deep scars suggest the use of hard hammer. These scrapers consist of two types of cross-sections—trapezoid (2) and sub-triangular (1). About 50-100% cortex is present on all scrapers. The average length, width, thickness, W/L, T/W and T/L is 12.4, 9.4, 4.8, 0.77, 0.51 and 0.39, respectively. The average of edge angle of three sides is 99°.

Modified artifacts (Table 4, 20 ; Fig. 79)

One modified flake and two modified chunks constitute this group.

Modified flake (1:33.3% out of modified artifacts). This is a elliptical side flake, having trapezoid cross-section. About 50-100% cortex is present. The length, width and thickness is 14.6, 8.2 and 5.5, respectively. The flake angle is of 120°.

Modified chunks (2:66.6%). These two pieces are polygon and irregular quadrilateral in cross-section. The average length, width and thickness is 8.8, 7.5 and 5.2, respectively.

Unmodified waste (Table 4, 9, 20 ; Fig. 79)

Two flakes and two flake fragments (mid portion) are the only members of this group.

Flakes (2 : 50% out of unmodified waste). These are side struck flakes, having short quadrilateral and short irregular plan form. Their cross-sections are planoconvex-high back and trapezoid. About 50-100% cortex is present on each flake. The average length, width, thickness and flake angle is 10.2, 8.4, 6.4 and 126° respectively.

The prominent bulb of percussion and high flake angle suggest the use of hard hammer.

Raw material and technique

All artifacts are fashioned on quartzite of various grain sizes and if without patination, purple in colour. But a thin layer of patination is present on all artifacts which has given a dirty yellow to dull brown colour to all artifacts. The hard and soft hammers as fabricator and direct percussion technique would have been used for manufacturing these artifacts. Further, flakes were detached from cores or boulders/cobbles using convenient platform with little or no previous preparation.

Tikura (TKR)

The sampled units of the site of TKR have yielded as many as nineteen artifacts, while at the initial stage of analysis, it was found that shaped tools formed the major components of the assemblage. It was represented by 12 tools forming 63.1% of the assemblage. The rest two groups—modified artifacts and unmodified waste are represented by 4 : 21% and 3 : 15.8%, res-

pectively (Table 4; Fig. 82). The general physical condition of artifacts show that they are mainly fresh and slightly abraded (16 : 84.2%), though moderately (2 : 10.5%) and heavily abraded (1 : 5.3%) are also present (Table 5). It may, however, be pointed out that they do not bear any sign of water rolling. Though in the absence of adequate soil cover the possibility of their minor displacement, through agencies other than water can not be ruled out. But in view of complete absence of water rolling evidences, it is perhaps, difficult to visualise the role of any major transportation of these artifacts. They on the whole seem to be almost in primary context, though not in mint condition. The patination is very thin.

Shaped tools (Table 4, 6, 22, 23; Fig. 83-84 : Plate XXVII)

The various forms of shaped tools have been grouped into four main tool classes. Out of main tool classes handaxes, cleavers, discoids and scrapers are represented by 16.7, 8.3, 25 and 50 percent, respectively.

Handaxes (2 : 16.7% out of shaped tools). These are made on indeterminate forms. On the basis of plan form both are ovate handaxes. These are semi-invasive, bifacial or parti-bifacial retouched. The presence of both deep and shallow scars suggest the use of hard and soft hammers. Their cross-sections are trapezoid and planoconvex-high back. The percentage of cortex on both handaxes is 0-50%. The average length, width, thickness, W/L, T/W and T/L is 11.4, 9.7, 5.4, 0.84, 0.57 and 0.48, respectively. The average edge angle of 4 sides is 93°.

Cleaver (1 : 8.3%). This is a parallel sided, squared butt cleaver on the end flake having straight bit. It is a semi-invasive and bifacial retouched cleaver. All evidences suggest the use of hard and soft hammers. Its cross-section is planoconvex-high back and has 0-50% cortex. The length, width and thickness is 12.5, 8.5 and 3.6, respectively. The average edge angle of two sides is 92.5°. The flake-cleaver technique is clearly visible in the manufacturing of this cleaver.

Discoids (3 : 25%). The primary forms of discoids consist of chunks (2) and cobble (1), having rhomboid cross-section. These are semi-invasive to invasive and parti-bifacial retouched specimens. The presence of deep scars suggest the use of hard hammer. Only one discoid retains 0-50% cortex and the rest have no cortex. The average length, width, thickness, W/L, T/W and T/L is 7.9, 6.5, 4.1, 0.82, 0.63 aud 0.51, respectively. The average edge angle of nine sides is 95.5°.

Scrapers (6 : 50%). The primary forms of scrapers consist of end flakes (3) and chunks (3). The sub-types of this main class are single side scraper

(2), three side scraper (1), end scraper (1), end and side scraper (1) and circular scraper (1). The lateral edge forms are convex (3), concave (1), denticulate (1) and convex-concave (1). These are steep semi-invasive and unifacial retouched scrapers. Deep and shallow scars suggest the use of hard and soft hammers. In the case of one scraper on flake, perhaps, hafting was made (Fig. 84 : 5) by removing two deep flakes at the proximal end. Their cross-sections consist of planoconvex-high back (1), sub-triangular (2), trapezoid (2) and irregular quadrilateral (1). About 25% scrapers have no cortex and the rest 25% and 50% have 50-100% and 0-50% cortex, respectively. The average length width, thickness, W/L, T/W and T/L is 10.1, 7.4, 4.4, 0.73, 0.59 and 0.44, respectively. The average edge angle of nine sides is 90°.

Modified artifacts (Table 4, 22 ; Fig. 82)

Only two types—modified flakes (2) and modified chunks (2) are present in this group.

Modified flakes (2 : 50% out of modified artifacts). Both are end flakes, having short quadrilateral and long irregular plan forms. Their cross-sections are triangular and sub-triangular. One has 0-50% cortex while the other 50-100% cortex. The average length, width, thickness, W/L, T/W and T/L is 11.4, 8.9, 4.2, 0.79, 0.47 and 0.37, respectively. The average flake angle, height and width of platform is 130°, 4.1 and 7.8, respectively.

Modified chunks (2 : 50%). These pieces have trapezoid and planoconvex-high back cross-sections. The average length, width and thickness is 10.3, 9.1 and 4.5, respectively.

Unmodified waste (Table 4, 9, 22; Fig. 82)

Only flakes are present in this group.

Flakes (3 : 100% out of unmodified waste). These are one side and two end struck flakes, having short quadrilateral, short-triangular and long irregular plan forms. Their cross-sections consist of triangular (1) and sub-triangular (2). Two flakes have 0-50% cortex and the third has 50-100% cortex. The average length, width, thickness, W/L, T/W and T/L is 11.2, 8.8, 3.7, 0.78, 0.44 and 0.33, respectively. The average of flake angle, height and width of striking platforms is 115°, 3 and 5.5, respectively.

The prominent bulb of percussion and high flake angle of these flakes suggest the use of hard hammers in course of detaching flakes out of cores/boulders.

Raw material and technique

All, except one on indeterminate material, artifacts are made on quartzite of various grain sizes and if without patination, purple in colour. But a thin layer of patination is present on all artifacts which has given a dirty yellow to dull brown colour to all artifacts. Generally, all artifacts would have been made by hard and soft fabricators through direct percussion technique. Moreover, flakes were struck from boulders/cobbles or cores, probably using convenient platform and with little or no previous preparation.

Artifacts extracted from the sections

Rampur-II (RMP-II)

The 22 artifacts collected from the exposed lower gravel at Rampur-II consist of shaped tools, modified artifacts and unmodified waste. The percentage of shaped tools, modified artifacts and unmodified waste is of 40.9% (9), 18.1% (4) and 40.9% (9), respectively. Shaped tools comprise of chopper (1), ovate handaxe (1), splayed cleavers (2), side knife (1), single side scraper (1), three sides scrapers (2) and end scraper (1) (Plate XXVIII). All the four modified artifacts are flakes. Unmodified waste consist of 8 flakes and one flake-core. All artifacts are made on quartzite, heavily abraded and bear evidence of water rolling. However, these artifacts are relatively fresh to those of collected at Mansava Ghat and Arahnia Ghat. On the basis of various attributes, this secondary context site belongs to Lower Palaeolithic period.

Mansava Ghat

A total number of 9 artifacts were collected from the lower deposit of Mansava Ghat section. Relatively fresh artifacts consist of small flakes (3), flake fragment (1), small single side scraper (1) and double side scraper (1). The striking platform of these flake artifacts consists of plain (4) dihedral (1) and faceted (1). All these artifacts are made on quartzite. Reasonable small size and other flint-knapping and typological attributes of these artifacts suggest that these artifacts belong to Middle Palaeolithic. Other three artifacts collected from the same section are heavily rolled and consist of ovate handaxe (1), side chopper (1) and spheroid and quite larger in dimension. These three artifacts show closer affinity with the Lower palaeolithic artifacts.

Arahnia Ghat

A total of 12 pieces were collected from the exposed river bed at Arahnia Ghat. Out of these, 4 specimen show no modification that can be associated

with the work of man. The rest 8 artifacts consist of flakes (3), handaxe (1) chopper (1), side scrapers (2) and cleaver (1) (Plate XXIX). All artifacts are made on quartzite and heavily rolled. These eight artifacts can be placed into Lower Palaeolithic period.

Satari section

From the Sagoni formation of this section, which is present in the village of Satari, eight microliths were recovered in course of scraping section. These microliths consist of backed blade (1), blade fragment (1), retouched/modified blade fragments (3), truncated and backed blade fragment (1), triangle (1), and scraper (1). The artifacts are made on chalcedony, chert, agate and carnalian (Plate XXX). These microliths are slightly rolled and patinated.

Rampur section

The section is present on the local nala in the village of Rampur. From the second deposit of this section, i. e., Rampur formation, seven microliths were recovered in course of scraping the section. These microliths are made on chalcedony and chert, and consist of backed blade fragment (1), triangle (1), lunate (1), retouched/modified blade fragment (1), blade (1) and flakes (2) (Plate XXXI). Like the microliths recovered from the Sagoni formation of the Satari section these microliths are also patinated and slightly rolled.

COMPARATIVE ANALYSIS

Under the section an attempt has been made to compare sites and sampled assemblages to know about similarity and dissimilarity between site settings and assemblages composition. For this purpose, this section has been divided into two.

I. Site comparison.
II. Assemblage comparison.

Site comparison

This sub-section deals with the comparative analysis of topographical features, site orientation, dimension of site, artifacts density and artifact distribution between sites.

All the eight Lower Palaeolithic sites are located more or less on high and low relief weathered rocks. However, four of them are close to nalas i. e. Sharda Temple-I (ST-I), Sharda Temple-II (ST-II), Sharda Temple-III (ST-III)

and Sharda Temple-IV (ST-IV), while the rest four are relatively closer to rivers. The later sites are Naru Hill (NRH), Belhata-II (BHT-II), Sagatha (SG1) and Tikura (TKR). Further, former types of sites are close to the chain of hills, which is present on the north-west of these sites, and the later sites, barring NRH which is on the north slope of the Naru Hill, are relatively in open area. The source of raw material is relatively closer to the five sites i. e. ST-I, ST-II, ST-III, ST-IV and NRH.

These sites are oriented in two directions, i. e., east to west and north to south. East to west oriented sites are ST-I, ST-II and ST-III, while the site of ST-IV, BHT-II, SGT, TKR and NRH are north to south oriented.

Judging from the available dimension of sampled population at every site, it appears that they can be grouped into two—large sites ranging from 450 m^2 to 960 m^2 and small sites ranging from 160 m^2 to 288 m^2. The four sites each fall into these two groups. The former includes ST-I, ST-II, ST-III and ST-IV, while the later consists of NRH, BHT-II, SGT and TKR (Table 3).

On the basis of artifacts density at every site, these sites can be grouped into two. The first group comprises artifacts density above 1 artifact per m^2 and includes ST-IV and NRH; the second group comprises all the rest six sites having artifacts density below 1 artifact per m^2 (Table 3). Further, the distribution of artifacts, as revealed from the personal observations and parameter total range of artifacts at every site, is more even among small sites and most uneven at ST-IV.

Assemblage comparison

This sub-section deals with the comparative analysis of different attributes observed and recorded in the preceding section of this chapter. The method and technique used in this section has been set out in chapter-2. Therefore, following the Stage I and Stage II as set out in chapter-2, this sub-section has been further divided into two for the sake of convenience to compare all types of attributes.

i. Discrete attributes.
ii. Metrical attributes.

Discrete attributes

For comparative analysis the following aspects of the discrete attributes of the artifacts have been analysed.

a. Abrasion
b. Raw material and flint-knapping techniques

c. Assemblage composition
d. Analysis of tool kit.
e. Analysis of main tool classes and tool types

Abrasion

In this research abrasion attribute of artifacts has been grouped into four—fresh (not mint fresh), slightly abraded, moderately abraded and heavily abraded. All sites have higher percentage of fresh and slightly-abraded artifacts, though slightly abraded artifacts are more common at every site, except Sharda Temple-II, where fresh artifacts out number the slightly abraded artifacts (Table 5; Fig. 85). Inspite of these variations, analysis of variance at 5% level of significance and given degree of freedom suggests that there is no significant difference among these assemblages. Further, a very thin layer of patination is present on the artifacts of each site.

Raw material and flint-knapping technique

Probably, no selection of raw material was made by the inhabitants of these sites. This is revealed from the fact that all artifacts of every assemblage at each site are fashioned on quartzite, except one indetermined material at Tikura, that would have been locally available as has been noticed in the field work.

The attribute primary form of shaped tools has been grouped into six—side flake, end flake, chunk, cobble/pebble, core and indeterminate pieces. More or less all groups are present in every assemblage at each site (Table 24; Fig. 86). However, the analysis of variance suggests a significant difference among primary forms of shaped tools of these assemblages

The attribute cross-section of shaped tools also has been grouped into eleven—biconvex, lanticular, planoconvex-high back, planoconvex-low back, triangular, sub-triangular, trapezoid, rhomboid, parallelogram, irregular quadrilateral and polygon. Almost all types of cross-sections are present in various frequencies in every assemblege at each site (Table 25; Fig. 87). Further, the analysis of variance also suggests that there is no significant difference among cross-sections of shaped tools of these assemblages.

The study of retouch class, retouch nature and invasiveness of artifacts show that there is no difference for these attributes among shaped tools of these assemblages. This is because of the fact that both types of scars i. e. deep and shallow are present on shaped tools, and further in all the assemblages bifaces have more scars on the dorsal face than the ventral. The presence of both deep and shallow scars suggests that both hard and soft hammers would have been used at every site for the manufacturing of shaped tools.

Depending upon the type of tool class and tool type in each assemblage they are either unifacial (normal/inverse) or bifacial or parti-bifacial or alternately retouched. From the point of view of invasiveness in all the assemblages it ranges from marginal to invasive, through semi-invasive. This invasiveness also depends upon the type of tool class or tool type.

The presence of cortex on shaped tools of these eight assemblages also suggests that there is no significant difference between these sites (Table 26; Fig. 88). Though variance is more within the assemblage than between the assemblages.

The most common plan forms of flakes in these eight assemblages are—short quadrilateral, long quadrilateral, short irregular and long irregular. Though, there is a close resemblance between ST-IV and NRH, both have all types of plan forms i. e. seven types as used in this study (Table 27; Fig. 89). Moreover, analysis of variance suggests that there is no significant difference among the plan forms of these eight assemblages.

Assemblage composition

The in between site analysis of the assemblage composition divided into three main groups—shaped tools, modified artifacts and unmodified waste, shows that in the assemblages of all the sites the percentage of shaped tools is higher than the modified artifacts and unmodified waste (Table 4 ; Fig. 90). The unmodified waste have relatively higher percentage in the assemblages of NRH, ST-IV and ST-III (Table 4; Fig. 90). The percentage of modified artifacts was found higher in the assemblages of BHT-II, TKR and NRH. The reading for the combination of later two groups, modified and unmodified, shows that the sites of NRH and ST-IV have higher percentage in comparison to other sites. It is represented by 28.8%, 19.3%, 39.9%, 40%, 41.1%, 36.8% at ST-I, ST-II, ST-III, BHT-II, SGT and TKR respectively, and at NRH and ST-IV by 58 9% and 50.8%, respectively (Table 4). At NRH unfinished tools dominate and at ST-IV also unfinished tools are present though relatively in small proportion.

The study of tool classes and tool types show that more or less all types of tool classes and tool types are present in the assemblages of all the sites. Further, handaxes such as ovate, elongate ovate and triangular, and quadrilateral cleavers are also present at every site. This suggests that all assemblages relatively belong to Upper late Acheulian tradition, as has been found in Africa and later Acheulian group of India.

Analysis of tool kit

The tool kit in this work consist of handaxes, cleavers, scrapers and knives. Here, an attempt has been made to retrieve statistical information of the

relationship of tool kit between the sites as well as within the sites. This attempt is based on the analysis of variance and proportional analysis using formulas stated earlier (chapter-2; Appendix-A; Fig. 4).

Handaxes, cleavers, scrapers and knives form the most common shaped tools in the assemblages of different sites. It is interesting to observe that cleavers followed by scrapers are dominant at the four out of eight sites i. e. ST-I, ST-IV, BHT-II and SGT. They are represented by 32.4% and 21.6% (ST-I), 39.4% and 15.1% (ST-IV), 41.7% and 25% (BHT-II) and 50% and 30% (SGT), respectively (Table-4). Handaxes dominate in the assemblages of ST-II and ST-III, cleavers hold the second position. They are represented by 28% and 24% (ST-II) and 36.4% and 30.3% (ST-III), respectively. Cleavers (37.5%) and handaxes (37.5%) have same frequencies at the site of NRH. Scrapers (50%), followed by discoids (25%) then followed by handaxes (16.7%) are dominant in the assemblage of TKR.

When data derived from the physical observations were processed through the analysis of variance it was found that there was no significant difference in the tool kits of different sites (Table 28; Fig. 91). However, the proportion analysis revealed significant differences only in the tool kits of the sites of ST-IV, ST-III and TKR.

As regards within site statistical analysis (*Chi-square test*) in respect of proportionate distribution of tool kit it was noticed that there was significant differences, excepting in the tool kit of BHT-II. The site-wise analysis is the following (Table 4).

ST-I. There is a significant difference between cleavers (12 : 32.4%) and knives (4 : 10.8%). Obviously cleavers hold the prominent position, though handaxes, scrapers are also principal tool classes of the tool kit.

ST-II. At this site a significant difference was noticed in the proportion of knives (3 : 6%) with handaxes (14 : 28%), cleavers (12 : 24%) and scrapers (10 : 20%).

ST-III. Handaxes (12 : 36 4%) significantly differ from scrapers (4 : 12.1%) and knives (4 : 12.1%), obviously handaxes occupy the prominent position followed by cleavers.

ST-IV. A significant difference was found in the proportional relationship of cleavers (13 : 39.4%) with handaxes (4 : 12.1%) and scrapers (5 : 15.1%). Cleavers, evidently, are the most important tool class in tool kit of this site.

NRH. Handaxes (6 : 37.5%) and cleavers (6 : 37.5%) significantly differ from scrapers (3 : 18.7%).

BHT-II. The tool kit consists of handaxes (1 : 8.3%), cleavers (5 : 41.7%) and scrapers (3 : 25%). No significant difference was found in the proportion of tool classes of this tool kit.

SGT. At this site the tool kit includes handaxes (1:10%), cleavers (5:50%) and scrapers (3 : 30%). However, cleavers significantly differ from the handaxes.

TKR. There is a significant difference in the proportion of scrapers (6 : 50%) and cleavers (1 : 8.3%).

Analysis of main tool classes and tool types

Tool classes. After analysing the inter and intra relationship of the composition of tool kit as a unit, we step into the proportional analysis of the main tool classes represented by handaxes, cleavers, scrapers and knives. This analysis deals obviously between the sites only.

Among handaxes of all the sites, the proportion of the same of the site ST-IV (4 : 12.1%) significantly differs from that of ST-III (12 : 36.4%) and NRH (6 : 37.5%) (Table 4).

The proportion of cleavers of TKR (1 : 8.3%) significantly differs from that of ST-IV (13 : 39.4%) and SGT (5 : 50%) (Table 4).

Regarding the situation of scrapers it was noticed that there was significant difference in the proportion of scrapers of TKR (6 : 50%) with that of ST-I (8 : 21.6%), ST-II (10 : 20%), ST-III (4 : 12.1%) and ST-IV (5 : 15.1%). At the remaining site no significant difference was indicated (Table 4).

Tool types. Here, we propose to analyse the inter and intra-site relationship of the tool types in terms of proportionate distribution.

The proportion of types of handaxes from the sites of SGT and BHT-II differs significantly with those of ST-I, ST-II and ST-IV. These two sites (SGT and BHT-II) have yielded one handaxe at each i. e. limande or sub-triangular. It appears handaxes would have not been frequently used at these sites. At the remaining sites no significant difference is indicated in the types of handaxes. As regards the intra-site proportion in the types of handaxes, it was found that there was no significant difference (Table 6).

The types of cleavers consist of convergent, divergent, parallel and splayed types (Table 6). In respect of the proportion of convergent cleaver the site of ST-I (nil) differs significantly with ST-II (5) and SGT (2). It may be pointed out that this type of cleaver forms the main type at the sites of ST-II and SGT. In the proportion of divergent and parallel cleavers significant differences were found between ST-1 (6) and ST-III (1) and between ST-II (1)

and ST-IV (6), NRH (3), BHT-II (3) and TKR (1), respectively. In splayed cleavers the site ST-IV (nil) differs significantly with the sites of ST-II (4) and ST-III (3). The intra-site relationship in the proportion of divergent (6) and splayed (1) types of cleavers shows that there is a significant difference between the two at ST-I. At the sites of ST-IV and BHT-II the splayed cleavers is absent, while the rest three types are present. The significant difference in respect of splayed cleavers is evident.

There is no significant difference in the inter-site relationship in terms of proportion of the types of scrapers excepting between the sites of ST-I and ST-II (Table 6). At ST-II the end and side scrapers (4) form the second dominant type, but the same is absent in ST-I. For the intra-site relationship also only one significant difference is indicated. It is in the proportion of single side (5) and end (1) scrapers of the site of ST-II.

Metrical attributes

For comparative analysis the following aspects of the metrical attributes of the artifacts have been analysed :

1. Analysis of three dimensions :
    a. Length (L), Width (W), Thickness (T).
    b. Ratio : width/length (W/L), thickness/width (T/W) and thickness/length (T/L).
2. Height and width of platform.
3. Angle of flakes and tool edges.

The metrical attributes relating to three dimensions have been analysed for handaxes, cleavers, scrapers and unmodified flakes as well as modified flakes and chunks. For obvious reasons the analysis of platform attributes have been dealt only with the flakes of different sites. The study of angles involves the flake angles of flakes and also lateral edges of handaxes, cleavers, scrapers, knives and discoids. Though the main emphasis is to gather information of their inter-site relationship in terms of metrical attributes, however, in the case of modified flakes and chunks only the intra-site relationship have been considered.

This metrical analysis is based on 't' test method. The level of significance is 5% with respective degree of freedom. All metrical data are mean based unless mentioned otherwise.

Analysis of three dimensions

Length, width and thickness. The handaxes of ST-II and ST-IV differ

significantly in their length and width which read 11.2 cm and 8.3 cm and, 13.7 cm and 10.5 cm, respectively. No significant difference is indicated in their thickness. The site of ST-I differs from both ST-II and ST-III only in the width. The width are 9.7 cm, 8.3 cm and 8.4 cm, respectively. ST-II differs from NRH only in thickness that reads 4.1 cm and 5.3 cm, respectively.

The cleavers of ST-IV (length 14.7 cm, thickness 5 cm) differ significantly in length from NRH (11.8 cm) and in thickness from those of ST-I (4.3 cm), ST-II (4.1 cm) and ST-III (4 cm). A significant difference is indicated also in the thickness (4.8 cm) and width (9.3 cm) of cleavers from BHT-II when compared with the former attribute to ST-II (4.1 cm) and ST-III (4 cm) and the later to (ST-II) and ST-III (4 cm) and the latter to ST-I (8.7 cm).

The scrapers of ST-III (6.6 cm) differ significantly in width from those of ST-I (10 cm), ST-II (9.3 cm) and SGT (9.4 cm). In width ST-II (9.3 cm) also differs from the site of TKR (7.4 cm).

Among unmodified flakes of different sites significant differences have been found in the metrical attributes of width and length. The flakes width of BHT-II (7.8 cm) differs from the sites of ST-I (9.5 cm). ST-IV (10.2 cm) and NRH (11.3 cm). The width of NRH (11.3 cm) also differs from those of ST-III (8.6 cm) and SGT (8.4 cm). In the flakes length, the site of ST-I (13 cm) differs from that of ST-III (10.4 cm).

Intra-site analysis between modified flakes and modified chunks reveals an interesting result. Except the site of NRH, all the sites show no significant difference, while at NRH, the significant difference is only of length and width.

Ratio : W/L, T/W, T/L. Among handaxes of different sites in question significant differences in various ratio are involved only with four sites. The site of TKR differs in W/L ratio (0.84) from ST-I (0.76), ST-II (0.73) and ST-III (0.73). In the T/L ratio ST-III (0.42) differs from ST-II (0.36).

The T/L ratio of cleavers of ST-II (0.27) interestingly enough differs from all the sites (Table 7, 10, 12, 14, 16, 18, 20, 22). Besides, ST-II also differs significantly in the W/L ratio (0.64) from SGT (0.73). Differences have also been noticed in T/L ratio between NRH (0.38) and ST-III (0.33), ST-I (0.33), and in the W/L ratio between ST-IV (0.65) and SGT (0.73).

Among scrapers significant difference has been noticed only in the W/L ratio of different sites. The site of ST-III (0.75) differs from ST-I (0.92), ST-II (0.8) and BHT-II (0.9). BHT-II and TKR (0.73) also differ further from ST-II (0.8) and ST-I (0.92), respectively.

The ratio of flakes in respect of either W/L or T/W or T/L or any two of them of ST-III and SGT show significant difference between them and with all the rest sites (Table 7, 10, 12, 14, 16, 18, 20, 22).

No significant difference is indicated between ST-IV and NRH, ST-IV and TKR, NRH and ST-II, ST-I and ST-II, ST-I and TKR and NRH and BHT-II in either single or any combination of ratio as have been considered here.

Intra-site analysis beetween modified flakes and modified chunks for three types of ratios in question suggested an interesting point that there is no significant difference among these sites for either of ratio except for W/L ratio at NRH and T/W at ST-I (Table 7, 10, 12, 14, 16, 18, 20, 22).

Height and width of platform

In analysing the metrical attributes of platform only the flakes of different sites have been considered for the obvious reasons. The attributes considered are height and width.

A significant difference is clearly indicated in the height of platform on flakes only between tha sites of ST-IV (4.1) and BHT-II (2.2). However, there is no significant difference in the width of flakes among sites in analysis (Table 9).

Analysis of angles

Needless to emphasize the importance of the study of angles in flint-knapping technique and tool uses. Technologically it is an important attribute of this that has to be considered in this type of work. Here, we have studied flake angles as well as side edge angles of handaxes, cleavers and scrapers of all the sites.

Regarding flake angles it is interesting to observe that significant difference is well indicated between SGT and the remaining sites, excepting the site of NRH. The angles are 126° at SGT and 119°, 118°, 115°, 117°, 116°, 115°, at the site of ST-I, ST-II, ST-III, ST-IV, BHT-II, and TKR, respectively, while 108° at the site of NRH (Table 9).

The lateral-edge angles of handaxes significantly differ only between ST-II (80.4°) and ST-III (90.9°). No significant difference is indicated at other sites (Table 8, 11, 13, 15, 17, 19, 21, 23). The side edge angles of cleavers of ST-II (80.7°) differ from ST-I (91°), ST-III (94.2°), ST-IV (93.3°), NRH (98.4°) and BHT-II (91.9°). The remaining sites do not offer any evidence of significant difference. However, the difference is clearly marked

in the edge angles of scrapers between the sites of SGT (99°) and ST-III (87.5°), and SGT and ST-II (85.7°), and ST-II and BHT-II (95.2°).

ANALYSIS OF FINDINGS

This section attempts to analyse the findings as derived from the comparative analysis of sites, assemblages, main tool kits, tool classes, and tool types in the preceding section with a view to determine the precise response of the findings to the problems raised in the opening chapter of this research work. Besides, the findings are also analysed for testing the model as proposed in chapter-2. The basic problems raised relate to (a) the determination of the locational features of the sites, (b) assessment of the cultural period of the sites (c) determination of the probable nature of sites, (d) identification of dominant activity relating to the subsistence as reflected in the tool kits and tool classes.

Before analysing the findings let us briefly summarise the first.

The sites assumed to be the Lower Palaeolithic are generally located on the low or high relief weathered rocks. On consideration of dimension, density of artifacts and parameter range of total artifacts of the sites, they may be divided into large and small sites as well as relatively long and short occupational sites.

The in between sites analysis of variance of the discrete attributes of assemblages such as abrasion, raw-material, cross-section, nature of retouch, class of retouch, retouch invasiveness, cortex, plan form of flakes, etc., revealed that there is no significant difference excepting in the primary forms of tools. This exception is probably due to differences in the proportion of tool classes. On the whole there is no significant difference in the method and technique as adopted at different sites for manufacturing the artifacts, so far as the analysis of variance is concerned. However, a few significant differences are indicated in the discrete attributes by the preliminary proportional analysis based on *chi-square* test.

The analysis of assemblage composition for main tool kits by analysis of variance also shows no significant difference. However, significant difference is well marked by the proportional analysis of main tool kits, tool classes and tool types.

For major tool classes and unmodified flakes the three dimensional analysis, though, shows some significant differences but they are not regular. However, mostly no significant difference is indicated between modified flakes and chunks at the site. The height and width of platform of flakes and the

flake angles also show no significant difference in most of the cases. Some significant differences, however, are present in the edge angles of tools.

In relation to findings of analysis it may be underlined that mostly the analysis of variance shows no significant difference while the analysis of proportion is generally marked by significant differences, the 't' test of metrical analysis also reveals that mostly there is no significant difference.

The above brief account of the findings is followed by their analysis with a view to retrieve information of their response to the problem raised. The coming sections will be dealt in accordance with the model set out in chapter-2.

We begin with the locational features of the sites. The sites are located either on the low or high relief weathered rocks. The relationship of sites and natural resources of water, raw material, games and plants reveals that the large sites are situated nearer to the nalas, raw material and hilly forest, while the small sites are invariably closer to the rivers and relatively in open area, except the site of Naru Hill. Moreover, the large sites are considerably away from the rivers and situated nearer to nalas seems to be generally protected at least on north-west sides by the chain of high hills. The forest present on hills, perhaps, would have been rich in plants and game resources.

Stage-I

Artifacts of all these assemblages are made on quartzite. These are locally available in the form of boulders and cobbles. However, if we accept the analysis of variance computed for primary forms there may be two explanations for the significant differences in the primary forms. First, the raw material i. e. quartzite would have been available in the form of boulders and cobbles if, we accept their present availability. Besides the collection of such boulders and cobbles prehistoric man also made some selective collection of small stone pieces and later they converted these stone pieces into shaped tools. This short cut method, obviously would have minimised the physical labour usually encountered in the collection of big boulders and breaking of boulders. The availability of such precise stone pieces vary from region to region which, probably, has given significant difference.

Second explanation can also be made about the significant difference in the primary forms. There are three types of sites, as interpreted in the subsequent sections, on the basis of proportion of tool classes i. e. handaxe dominating cleaver dominating and scraper dominating sites. Handaxes are mostly made on chunks, cleavers on flakes and scrapers on both chunks and flakes. So that, the variability in the proportion of these tool classes ultimately has given a

difference in the primary forms of shaped tools. In these assemblages tools are made on almost every type of primary form. It suggests that this difference is also due to the difference in the proportion of tool classes.

The analysis of variance for cross-section, presence of cortex of shaped tools and plan forms of flakes, all suggest that there is no significant difference between the artifacts of the sites. Though, preliminary proportional analysis of these attributes suggest that there are some significant differences between sites. The analysis of retouch class, retouch nature and invasiveness also revealed that there is no difference between sites, though minor differences are present. The hard, medium hard and soft fabricators might have been used for direct percussion technique depending upon the tool type and the stage of tool manufacturing.

All the above observations and calculations reveal that the inhabitants of these sites would have been of the similar cultural period and tradition, having more or less similar mental ability for flint-knapping and selecting raw material. The minor differences between sites probably due to the work of different group living in the similar environment and mental capacity.

The above inferences about discrete attributes are also supported by the metrical analysis of main tool classes and flakes. There are some significant differences between sites regarding three dimensional measurements, but no regular significant difference is noticed. The minor differences might be due to either slight change in the climate or change in hunting/gathering technique and/or the work of different groups.

Furthermore, 't' test analysis between modified flakes and modified chunks within site for three dimensional measurement revealed that mostly the collection of small stone pieces would have not been made haphazardly. The differences in the edge angle of scrapers and discoids between short and long occupational sites, perhaps, show some sort of different type of minor activities.

Considering the above mentioned facts and inferences it can be said that these eight sites belong to same cultural period, which on the basis of typology and technology belong to Lower Palaeolithic period and particularly belong to Upper/Late Acheulian tradition (later Acheulian tradition in Indian context). All the above similarity and dissimilarity show method and technique (manner) (cf. Crabtree, 1972 : 2-3), respectively. This is because of the fact that especially in the flint-knapping method means mind and technique means hand (Crabtree, 1972 : 2-3). Some dissimilarity might be due to either slight change in climate and/or work of different groups or slight change in hunting and gathering technique and/or change in minor activities.

The analysis of variance of main tool kits also support the above inferences. This analysis shows that there is no significant difference between sites regarding main tool classes. It can be inferred that there would have been, perhaps, no difference in the environment/universe or general requirements of the inhabitants of these sites. To fulfill primary needs the inhabitants of each site were using almost similar tools.

Stage-II

If we accept the above inferences some serious questions arise why there is a difference in tool proportion between sites ? Does it reflect different suits of activities and human behaviour ? To answer such questions comparative analysis has been made on the model set out in chapter-2. In the following sections inferences will be made about the results provided by statistical model.

Step-I. The proportional test of main tool kits suggest that there are significant differences between tool kit of Sharda Temple-III and Tikura, Sharda Temple-III and Sharda Temple-IV, and Sharda Temple-IV and Tikura. The rest five sites show no significant difference with any sites regarding the main tool kit. As far as the reliability of this test stands, it can be deduced that these sites show four types of tool kits-tool kit of (1) type site Sharda Temple-III, (2) Type site Sharda Temple-IV, (3) type site Tikura, and (4) common tool kits represented by Sharda Temple-I, Sharda Temple-II, Belhata-II, Sagatha and Naru Hill. Thus, it can be inferred that there are four types of tool kits representing three types of activities.

Step-II. The proportional analysis of main tool classes suggests that Sharda Temple-III and Naru Hill significantly differ from Sharda Temple-IV in the proportion of handaxe. The site of Sharda Temple-III has higher proportion of handaxe than Sharda Temple-IV. The Sharda Temple-IV significantly differs from Tikura in the proportion of cleavers, which is higher in the tool kit of Sharda Temple-IV. Lastly, Tikura significantly differs from Sharda Temple-IV, Sharda Temple-III, Sharda Temple-II and Sharda Temple-I in the proportion of scrapers, as Tikura has higher proportion of scrapers. Intrasite tool class proportional analysis suggests almost similar results.

Combining together the step-I and step-II it can be inferred that the first second and third tool kit is dominated by handaxes, cleavers and scrapers respectively. The fourth tool kit has common proportion for these tool classes. Thus, on these grounds it can be said that if these tool classes were related and made for one particular activity, which is more likely, then that respective activity was more at Sharda Temple-III, Sharda Temple-IV and

Tikura. At the rest of the sites, there was probably no preference for these activities.

Step-III. Intrastite analysis of common tool kit bearing sites such as Sharda Temple-I, Sharda Temple-II, Sagatha and Belhata-II show that at Sharda Temple-I, Sagatha and Belhata-II cleaver activity was, probably, more than handaxe activity, while at Sharda Temple-II handaxe activity was probably more than cleaver activity. It has been noticed that the percentage of broken biface is slightly more at cleaver dominating site, than handaxe dominating sites. Further, mostly dimension and refinement of tools at cleaver dominating sites are relatively big and less refined than those of handaxe dominating sites. Does it reflect cleaver activity tool kit needs slightly bigger and less refined tools ? However, nothing can be said at this state of our knowledge, perhaps, through experiments with such type of tools could throw some light on such questions.

Step-IV. Under this step each tool class was analysed to know proportional difference between sites for their tool types.

It is found that the proportion of tool types of handaxes show no significant difference between sites, except Belhata-II and Sagatha. These two sites differ from Sharda Temple-I, Sharda Temple-II and Sharda Temple-IV. Belhata-II and Sagatha have one handaxe each .i e. one type of handaxe and those types are absent in other three sites. On this ground no positive inference can be made. However, this can be said that the absence of these types might have effected some types of activity that could be carried out more easily by these types, or that activity might have been absent or compensated by other types of handaxes.

The similar inferences can also be made about scrapers of Sharda Temple-II, which differ from Sharda Temple-I for end and side scraper, which is absent at Sharda Temple-I. The rest of the sites show no significant difference.

It appears from proportional analysis of cleaver types that there are some significant differences in the proportional use of different types of cleavers. This suggests that besides those activities which would have been performed by other types of cleavers showing no significant differences, some special type of activities were also carried out by parallel sided cleavers at Sharda Temple-IV, Belhata-II, Naru Hill and Tikura in comparison to Sharda Temple-II where it is very low in proportion. The same is true for divergent cleavers between Sharda Temple-I and Sharda Temple-III which are in low proportion at the latter site. Sharda Temple-II and Sharda Temple-III also differ from Sharda Temple-IV for splayed cleavers, which are absent at Sharda Temple-IV. Sharda Temple-I has only one convergent cleaver and differ from Sharda Temple-II and Sagatha.

All the above significant differences suggest that mostly there is no difference in types of handaxes and scrapers but types of cleavers differ. These differences suggest presence or absence of some type of activity which could be performed by that tool type and/or might have been adjusted by other present tool types.

Step-V. Intrasite analysis of tool types suggests that there would have been no preference to any type of handaxe at any site. At Sharda Temple-II end and single side scraper and at Sharda Temple-I divergent cleavers would have been preferred. This preference is either due to efficiency of tool type for the particular activity performed by that tool type or personal preference. Without microwear analysis no definite inference can be made about step-IV and step-V, though it has been observed that prehistoric men had realised the importance of efficiency of tool types and different motional activities (Keeley, 1980 : 86-165 ; Moss, 1983 : 131-37 ; Sinha and Glover, 1984).

Thus on the above grounds it can be inferred that there are four types of tool kits and three types of main activities in the region during Upper/late Acheulian tradition. First dominant activity would have been performed by handaxes, second by cleavers and third by scrapers.

Besides above findings, the other observations suggest that frequencies of unmodified waste and modified artifacts are higher in the assemblage of Naru Hill and Sharda Temple-IV than at other remaining sites. The biface-trimming flakes are found at Sharda Temple-IV, Sharda Temple-I and Sharda Temple-II, which shows that beside other activities some flint-knapping activity was also going on at these sites. However, the frequency of these biface-trimming flakes is higher in the assemblage of Sharda Temple-IV, which also has higher proportion of unmodified waste. At Naru Hill, the frequency of handaxes and cleavers is same and scrapers hold second position. The availability of raw material is very close to the Naru Hill and the higher proportion of unmodified waste, modified artifacts and unfinished shaped tools at this site reveal some different nature of the site. It has been often reported that factory sites have both finished and unfinished tools, but the review of published literature and analysis of such identified factory sites reveal that factory sites in fact have more finished tools than unfinished tools. Therefore, it would, to some extent, not be proper to assign such types of sites only as factory sites. If, prehistoric man was making tools at one site, then why he would have left higher frequency of finished tools. From various points of view they would have made only required number of tools. Further, one more point that needs verification i.e. whether the unfinished tools are really in the stage of manufacturing or in reality are rejected pieces. To answer such type of question require flint-knapping experiments, keeping the above raised points in mind, which is one of the future aims of the present researcher. However, it can be said tentatively that a few of unfinished tools

of Naru Hill are seen to be rejected pieces. Lastly, considering the above facts, Naru Hill would have been a factory site, while Sharda Temple-IV habitational-cum-factory site.

Thus, after considering the above mentioned factors, the following nature to these sites and assemblages can be tentatively proposed. The sites of Sharda Temple-I, Sharda Temple-II, Belhata-II and Sagatha have common activity tool kit though cleaver activity was, probably slightly more than handaxe activity at the site of Sagatha. The dominating activity at the sites of Sharda Temple-III, Sharda Temple-IV and Tikura is handaxe, cleaver and scraper, respectively.

The site of Naru Hill is relatively short occupational factory site, while the sites of Belhata-II and Sagatha are relatively of short occupation habitational sites. The site of Tikura is relatively of short occupational site. Sharda Temple I, Sharda Temple-II and Sharda Temple-III are relatively of long occupation habitational sites, while the site of Sharda Temple-IV is relatively of long occupation habitational-cum-factory site.

Stage-III

It is interesting to note that more or less similar results have been obtained from the cumulative graphs of main groups of assemblages (Fig. 92), tool classes (Fig. 93) and tool types (Fig 94 ; Table 29) of these sites. The average-link correlation coefficient dendogram also suggest that at 37% of dissimilarity there are three groups—cleaver dominating, handaxe dominating and scraper dominating groups, and Sharda Temple-I is intermediatory between the groups of cleaver and handaxe dominating sites. Moreover, at 52.5% of dissimilarity there are two groups—scraper dominating site and handaxe -cleaver dominating sites (Fig. 95).

Note

1. Besides antler, wood and bone, in this research the term soft hammer also includes medium sized, rounded and light weight stone hammers.

DESCRIPTIONS OF ILLUSTRATED ARTIFACTS

Figure 54. *Artifact drawings : Sharda Temple-I.*

1. Ovate handaxe on side flake, complete, deep and shallow scars, unifacial marginal retouched, planoconvex-high back cross-section, slightly abraded, 0-50% cortex, 11.8×9.7×4.4 (ST-I, 16).

2. Untrimmed butt handaxe on indeterminate form, complete, deep and shallow scars, bifacial invasive retouched, polygon cross-section, slightly abraded, 0-50% cortex, 13.6×10.2× 5.3 (ST-I, 14).

3. Convergent, round ended pick on end flake, deep and shallow scars, bifacial semi-invasive retouched, planoconvex-low back cross-section, slightly abraded, 0% cortex, 16.3×10.3×4.4 (ST—I, 22).

Figure 55. *Artifact drawings : Sharda Temple-I.*

1. Divergent cleaver on side flake, complete, deep and shallow scars, bifacial semi-invasive retouched, irregular quadrilateral cross-section, slightly abraded, 0-50% cortex (old weathered surface), 12.1×8 4×5.2 (ST-I, 10).

2. Parallel cleaver on side flake, complete, deep and shallow scars, bifacial semi-invasive retouched, trapezoid cross-section, slightly abraded, 0-50% cortex (old weathered surface), 16.7× 10.1×5.5 (ST-I, 6).

3. Limande handaxe on end flake, complete, deep and shallow scars, bifacial semi-invasive retouched, biconvex cross-section, slightly abraded, 0-50% cortex, 13.6×9.2×5.5 (ST-I, 17).

Figure 56. *Artifact drawings : Sharda Temple-I.*

1. End and side knife on indeterminate form, complete, deep and shallow scars, bifacial invasive retouched, sub-triangular cross-section, slightly abraded, 0% cortex, 12.6×9.4×3.4 (ST-I, 15).

2. Side knife on chunk, complete, deep and shallow scars, partibifacial semi-invasive retouched, trapezoid cross-section, slightly abraded, 0-50% cortex, 12.7×8.4×4.5 (ST-I, 35).

3. Single side scraper on end flake, complete, deep scars, unifacial (inverse) semi-invasive retouched, planoconvex-high back cross-section, slightly abraded, 50-100% cortex, 14.1 × 10.8 × 6 (ST-I, 26).
4. Single side scraper on end flake, complete, deep scars, unifacial (normal) semi-invasive retouched, triangular cross-section, slightly abraded, 0% cortex, 8.2 × 4.5 × 3.1 (ST-I, 30).
5. Bec on chunk, complete, deep scars, alternate semi-invasive retouched, planocovex-low back cross-section, slightly abraded, 0% cortex, 9 × 7.6 × 2.8 (ST-I, 34).

Figure 59. *Artifact drawings : Sharda Temple-II.*

1. Parallel cleaver on end flake, complete (tip slightly broken), deep and shallow scars, bifacial invasive retouched, biconvex cross-section, fresh, 0-50% cortex, 14.8 × 10 × 5 (ST-II, 18).
2. Convergent cleaver on side flake, complete, deep and shallow scars, bifacial invasive retouched, biconvex cross-section, fresh, 0% cortex, 14.8 × 8.7 × 3.5 (ST-II, 7).
3. Elongate ovate handaxe on side flake, deep and shallow scars, parti-bifacial semi-invasive retouched, trapezoid cross-section, fresh, 0% cortex, 14 × 9.6 × 4.6 (ST-II, 5).

Figure 60. *Artifact drawings : Sharda Temple II.*

1. Ovate handaxe on indeterminate form, complete, deep and shallow scars, bifacial invasive retouched, biconvex cross-section, fresh, 0-50% cortex, 13.3 × 10.2 × 3.5 (ST-II, 4).
2. End and side knife on side flake, complete, deep and shallow scars, bifacial invasive retouched, triangular cross-section, fresh, 0-50% cortex, 13.2 × 7.4 × 5 (ST-II, 28).
3. Double pointed handaxe on side flake, complete, deep and shallow scars, parti-bifacial invasive retouched, trapezoid cross-section, fresh, 0-50% cortex, 11.6 × 8.7 × 4.5 (ST-II, 9).

Figure 61. *Artifact drawings : Sharda Temple-II.*

1. Splayed cleaver on chunk, complete, deep and shallow scars, parti-bifacial semi-invasive retouched, trapezoid cross-

section, slightly abraded, 0-50% cortex, $10.8 \times 6.1 \times 4.4$ (ST-.I, 25).

2. End and side scraper on chunk, complete, deep scars, semi-invasive retouched, trapezoid cross-section, fresh, 0-50% cortex (old weathered surface), $12.5 \times 10 \times 5$ (ST-II, 40).

3. Side struck biface trimming flake, complete, short quadrilateral plan form, slightly abraded, 0-50% cortex, $6.3 \times 5 \times 2.1$. (ST-II, 55).

4. Side struck biface trimming flake, complete, short triangular plan form, fresh, 0% cortex, $5.5 \times 4.2 \times 1.8$ (ST-II, 56).

5, Discoid on chunk, complete, deep scars, parti-bifacial invasive retouched, rhomboid cross-section, fresh, 0-50% cortex, $8.5 \times 7.1 \times 5.8$ (ST-II, 49).

6. Single side scraper on chunk, complete, deep scars, unifacial (normal) semi-invasive retouched, irregular quadrilateral cross-section, fresh, 50-100% cortex, $9.6 \times 8.5 \times 3.4$ (ST-II, 39).

7. Side struck flake, complete, long quadrilateral plan form plain striking platform, sub-triangular cross-section, 0-50% cortex, fresh, $14.5 \times 13.6 \times 3.7$ (ST-II, 59).

Figurs 64. *Artifact drawings : Sharda Temple-III.*

1. Cordiform handaxe on end flake, complete, deep and shallow scars, parti-bifacial semi-invasive retouched, planoconvex-low back cross-section, slightly abraded, 0% cortex, $14.2 \times 9.2 \times 3.5$ (ST-III, 11).

2. Ovate handaxe on indeterminate form, complete, deep and shallow scars, parti-bifacial invasive retouched, biconvex cross-section, slightly abraded, 0-50% cortex, $12 \times 9.7 \times 5.7$ (ST-III, 20).

3. Sub-triangular handaxe on indeterminate form, complete, deep and shallow scars, bifacial semi-invasive retouched, biconvex cross-section, slightly abraded, 0-50% cortex, $12.2 \times 8.7 \times 4.5$ (ST-III, 14).

Figure 65. *Artifact drawings : Sharda Temple-III.*

1. Sub-triangular handaxe on indeterminate form, complete, deep and shallow scars, parti-bifacial semi-invasive retouched,

planoconvex-high back, slightly abraded, 0-50% cortex, 11.7 × 8.6 × 4.2 (ST-III, 16).

2. Splayed cleaver on indeterminate form, complete, deep and shallow scars, bifacial invasive retouched, biconvex cross-section, slightly abraded, 0-50% cortex, 15.2×9.2×4.2 (ST-III, 1).

3. Parallel cleaver on indeterminate form, complete, deep and shallow scars, bifacial invasive retouched, trapezoid cross-section, slightly abraded, 0% cortex, a few $CaCO_3$ concretion, 14×8.3×3.2 (ST-III, 3).

Figure 66. *Artifact drawings : Sharda Temple-III.*

1. Side knife on chunk, complete, deep and shallow scars, bifacial semi-invasive retouched, sub-triangular cross-section, slightly abraded, 50-100% cortex (old weathered surface), 13.2×7.1×4 (ST-III, 24).

2. Discoid on cobble, complete, deep and shallow scars, parti-bifacial semi-invasive retouched, polygon cross-section, slightly abraded, 0-50% cortex, 9.5×9×5.9 (ST-III, 27).

3. Splayed cleaver on end flake, complete, miniature, deep and shallow scars, bifacial semi-invasive retouched, trapezoid cross-section, slightly abraded, 0% cortex, 8×6.6×3.2 (ST-III, 2).

4. Circular scraper on side flake, complete, deep scars, unifacial (normal) semi-invasive retouched, trapezoid cross-section, slightly abraded, 0% cortex, 10.6×8.3×4 2 (ST-III, 29).

Figure 69. *Artifact drawings : Sharda Temple-IV.*

1. Parallel cleaver on side flake, complete, deep and shallow scars, bifacial semi-invasive retouched, planoconvex-high back cross-section, fresh, 0-50% cortex, 12.2×9×5 (ST-IV, 5).

2. Parallel cleaver on end flake, complete, deep and shallow scars, unifacial marginal retouched, parallelogram cross-section, slightly abraded, 0% cortex, a few $CaCO_3$ concretions, 11×7.4×5.2 (ST-IV, 8).

3. Parallel cleaver on end flake, complete, deep and shallow scars, cleaver edge retouched by shallow scars, dorsal face, bifacial

semi-invasive retouched, trapezoid cross-section, fresh, 0% cortex, a few $CaCO_3$ concretions, 17.2 × 10.5 × 5.5 (ST-IV, 2).

Figure 70. *Artifact drawing : Sharda Temple-IV.*

1. Ovate handaxe on indeterminate form, complete (except tip), deep and shallow scars, bifacial semi-invasive retouched, biconvex cross-section, slightly abraded, 0-50% cortex, 13 × 10.3 × 4.9 (ST-IV, 16).

2. Ovate handaxe on indeterminate form, complete, deep and shallow scars, bifacial invasive retouched, polygon cross-section, slightly abraded, 0-50% cortex (old weathered surface), 11.8 × 9.5 × 6.5 (ST-IV, 23).

3. Bec on chunk, complete, deep and shallow scars, alternate semi-invesive retouched, irregular quadrilateral cross-section, fresh, 0-50% cortex, a few $CaCO_3$ concretions, 18 × 12 × 4.7 (ST-IV, 26).

4. Sub-spheroid on chunk, complete, deep scars, bifacial invasive retouched, polygon cross-section, slightly abraded, 0-50% cortex, 9 8 × 8.2 × 7.4 (ST-IV, 33).

Figure 71. *Artifact drawings : Sharda Temple-IV.*

1. Core scraper, complete, deep scars, unifacial semi-invasive retouched, rhomboid cross-section (triangular specimen), slightly abraded, 0-50% cortex, a few $CaCO_3$ concretions, 16.1 × 8.4 × 6.9. (ST-IV, 30).

2. End struck flake, complete, long quadrilateral plan form, inclined platform, slightly abraded, 50-100% cortex, 18 × 14 × 6.7 (ST-IV, 53).

3. Side struck biface trimming flake, complete, short irregular plan form, 0% cortex, 5.8 × 4.2 × 1.6 (ST-IV, 60).

4. Side struck biface trimming flake, complete, short quadrilateral plan form, 0% cortex, 6 × 5.1 × 1.8 (ST-IV, 59).

Figure 74. *Artifact drawings : Naru Hill.*

1. Sub-triangular handaxe on chunk, complete, deep scars, parti-

bifacial invasive retouched, rhomboid cross-section, slightly abraded, 0-50% cortex, 10×8.5×5.8 (NRH, 1).

2. Splayed cleaver on indeterminate form, complete, deep scars, parti-bifacial semi-invasive retouched, trapezoid cross-section, slightly abraded, 0-50% cortex, 9.1×8.8×4.5 (NRH, 11).

3. Side knife on chunk, complete, deep and shallow scars, bifacial semi-invasive retouched, trapezoid cross-section, slightly abraded, 0-50% cortex, 12.5×9.3×3.8 (NRH, 13).

Figure 75. *Artifact drawings : Naru Hill.*

1. Untrimmed butt handaxe on end flake, complete, deep scars, bifacial semi-invasive retouched, planoconvex-high back cross-section, slightly abraded, 0-50% cortex (old weathered surface), 15×9.6×4.5 (NRH, 2).

2. Convergent cleaver on side flake, complete (cleaver edge slightly broken), deep scars, unifacial semi-invasive retouched, trapezoid cross-section, moderately abraded, 50-100% cortex (including old weathered surface), 13.7×9.1×5.3 (NRH, 9).

3. Single side scraper on end flake, complete, deep scars, unifacial (normal) semi-invasive retouched, trapezoid cross-section, slightly abraded, 50-100% cortex, 16.2×10.3×4.4 (NRH, 14).

4. End flake, complete, long irregular plan-form, sub-triangular cross-section, 0-50% cortex, 13.7×12.2×4.4 (NRH, 31).

Figure 78. *Artifact drawings : Belhata-II.*

1. Parallel cleaver on side flake, complete, deep and shallow scars, bifacial semi-invasive retouched, parallelogram cross-section, slightly abraded, 0-50% cortex, 15.8×9.5×4.8 (BHT II, 4).

2. Sub-triangular handaxe on chunk, complete, deep and shallow scars, unifacial semi-invasive retouched, sub-triangular cross-section, fresh, 0-50% cortex, 13.5×9.2×4.5 (BHT II, 6).

3. Angled scraper on chunk, complete, deep and shallow scars, alternate semi-invasive retouched, sub-triangular cross-section, slightly abraded, 0-50% cortex, 11.6×10.5×5 5 (BHT II, 12).

4. Single side scraper on end flake, complete, deep scars, unifacial

(normal), marginal retouched, sub-triangular cross-section, slightly abraded, 0-50% cortex, 7.3×7.1×2.5 (BHT II, 11).

5. Side struck flake, complete, long quadrilateral, trapezoid cross-section, 0-50% cortex, 11.3×8×4.1 (BHT II, 16).

Figure 81. *Artifact drawings : Sagatha.*

1. Divergent cleaver on indeterminate form, complete, deep and shallow scars, bifacial semi-invasive retouched, irregular quadrilateral cross-section, moderately abraded, 50-100% cortex, 15.1×10 4×4.8 (SGT, 1).

2. Limande handaxe on indeterminate form, complete, deep and shallow scars, parti-bifacial semi-invasive retouched, planoconvex-low back cross-section, moderately abraded, 0-50% cortex (old weathered surface), 14.5×10.5×4.5 (SHT, 6).

3. Single side scraper on core, complete, deep and shallow scars, unifacial semi-invasive retouched, sub-triangular cross-section, moderately abraded, 50-100% cortex, 15×9.2×4.8 (SGT, 8).

4. Single side scraper on chunk, complete, deep and shallow scars, unifacial semi-invasive retouched, trapezoid cross-section, slightly abraded, 50-100% cortex, 10×9.1×4 (SGT, 9).

Figure 84. *Artifact drawings : Tikura.*

1. Parallel cleaver on end flake, complete, deep and shallow scars, bifacial semi-invasive retouched, planoconvex-high back cross-section, moderately abraded, 0-50% cortex, a few $CaCO_3$ concretions, 12.5×8.5×3.6 (TKR, 30).

2. Ovate handaxe on chunk, complete, deep and shallow scars, bifacial semi-invasive retouched, planoconvex-high back cross-section, slightly abraded, 0-50% cortex (old weathered surface), 11.8×10.4×4 3 (TKR, 2).

3. Circular scraper on chunk, complete, deep and shallow scars, unifacial semi-invasive retouched, irregular quadrilateral cross-section, fresh, 0-50% cortex, 8.2×6.6×6.1 (TKR, 8).

4. Three side scraper on chunk, complete, deep and shallow scars, unifacial semi-invasive retouched, planoconvex-high back

cross-section, fresh, unidentified raw material, 0-50% cortex, 8.6 × 4.8 × 2.7 (TKR, 9).

5. End scraper on end flake complete, deep and shallow scars, unifacial (normal) semi-invasive retouched, trapezoid cross-section, fresh, two big flakes removed from the ventral face, 0-50% cortex (old weathered surface), 13.2 × 10.3 × 4.6 (TKR, 5).

6. Discoid on chunk, complete, deep and shallow scars, partibifacial invasive retouched, rhomboid cross-section, fresh, 0% cortex, 6.6 × 5.6 × 2.8, (TKR, 10).

Form No.—16

LIST OF TABLES, FIGURES AND PLATES

Tables

21. Statistical data on edge angle of tool classes from Sagatha.

22. Dimensions (cm) of artifacts from Tikura.

23. Statistical data on edge angle of tool classes from Tikura.

24. Frequency of primary form of shaped tools in each of the Lower Palaeolithic assemblage.

25. Frequency of cross-sections of shaped tools in each of the Lower Palaeolithic assemblage.

26. Frequency of cortex groups of shaped tools in each of the Lower Palaeolithic assemblage.

27. Frequency of plan form of flakes in each of the Lower Palaeolithic assemblage.

28. Frequency of tool classes of main tool kits in each of the Lower Palaeolithic assemblage.

29. Detailed inventory of the tool types recognised in each of the Lower Palaeolithic assemblage.

Figures

Plates

Table 2. Inventory of Stone Age sites in the sampled population : study area, Satna district, Madhya Pradesh.

Cultural Period	Sampled Unit Numbers												
	3	6	11	14	16	18	19	27	45	57	59	64	Total
Lower Palaeolithic	—	—	—	—	2	—	—	2	—	—	—	4	8
Middle Palaeolithic	—	—	1	—	2	—	—	—	—	—	—	1	4
Upper Palaeolithic	—	—	1	—	—	—	1	—	—	—	—	—	2
Mesolithic	—	—	1	—	—	—	2	—	—	—	—	1	4
Total	—	—	3	—	4	—	3	2	—	—	—	6	18

Table 3. Statistical data on the Lower Palaeolithic sites recognised in the sampled population : study area, Satna district (Madhya Pradesh).

Site	I	II	III	IV	V	VI	VII	VIII	IX	X
Sharda Temple-I	800	48	5	16	0.65	10.4	1.14	0.47	9.48—11.32	455—543
Sharda Temple-II	960	60	6	16	0.64	10.3	1.96	0.75	8.8—11.8	528—708
Sharda Temple III	800	48	5	16	0.68	11	1.22	0.50	10.02—11.98	481—575
Sharda Temple-IV	450	50	5	9	1.48	13.4	4.39	1.84	9.8—17	490—850
Naru Hill	160	40	4	4	2.43	9.7	1.25	0.58	8.6—10.8	344—432
Belhata-II	270	30	3	9	0.74	6.7	1.52	0.72	5.3—8.1	159—243
Sagatha	288	18	2	16	0.53	8.5	0.70	0.43	7.7—9.3	139—167
Tikura	288	18	2	16	0.59	9.5	2.12	1.31	6.9—12.1	124—218

Key :

I=Area of site (m^2).
II=Total sample units.
III=Total sampled units.
IV=Area of unit (m^2).
V=Artifacts density (per m^2).
VI=Mean.
VII=Standard deviation.
VIII=Standard error.
IX=Parameter mean range.
X=Total artifacts range.

Table 4. Inventory of the artifacts classes recognised in each of the Lower Palaeolithic assemblage.

Artifacts	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Shaped Tools																
Choppers	—	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	1	3	—	—	—	—	—	—	—	—
Handaxes	6	16.2	14	28	12	36.4	4	12.1	6	37.5	1	8.3	1	10	2	16.7
Cleavers	12	32.4	12	24	10	30.3	13	39.4	6	37.5	5	41.7	5	50	1	8.3
Knives	4	10.8	3	6	4	12.1	—	—	1	6.2	—	—	—	—	—	—
Picks	1	2.7	1	2	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	3	8.1	1	2	1	3	8	24.2	—	—	3	25	1	10	—	—
Sub-spheroids	1	2.7	—	—	—	—	1	3	—	—	—	—	—	—	—	—
Discoids	1	2.7	9	18	1	3	—	—	—	—	—	—	—	—	3	25
Scrapers	8	21.6	10	20	4	12.1	5	15.1	3	18.7	3	25	3	30	6	50
Becs	1	2.7	—	—	—	—	1	3	—	—	—	—	—	—	—	—
Total	37	100	50	100	33	99.9	33	99.8	16	99.9	12	100	10	100	12	100
		(71.1)*		(80.6)		(60)		(49.2)		(41)		(60)		(58.8)		(63.1)

Table 4. (Contd.)

Artifacts	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Modified Artifacts																
Modified flakes	3	50	2	50	4	80	8	100	1	11.1	1	20	1	33.3	2	50
Modified chunks	3	50	2	50	1	20	—	—	8	88.8	4	80	2	66.6	2	50
Total	6	100	4	100	5	100	8	100	9	99.9	5	100	3	99.9	4	100
		(11.5)		(6.4)		(9)		(11.9)		(23)		(25)		(17.6)		(21)
Unmodified waste																
Flakes	8	88.9	4	50	10	58.8	18	69.2	11	78.6	2	66.7	2	50	3	100
Flake fragments	—	—	—	—	4	23.5	3	11.5	2	14.3	1	33.3	2	50	—	—

Table 4. (Contd.)

Artifacts	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Unmodified waste																
Biface trimming																
flakes	1	11.1	2	25	—	—	5	19.2	—	—	—	—	—	—	—	—
Cores	—	—	2	25	3	17.6	—	—	1	7.1	—	—	—	—	—	—
Total	9	100 (17.3)	8	100 (12.9)	17	99.9 (30.9)	26	99.9 (38.9)	14	100 (35.9)	3	100 (15)	4	100 (23.5)	3	100 (15.8)
Grand Total	52	(99.9)	62	(99.9)	55	(99.9)	67	(99.9)	39	(100)	20	(100)	17	(99.9)	19	(99.9)

Key :

ST-I=Sharda Temple I.
ST-II=Sharda Temple-II.
ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV.

NRH=Naru Hill.
BHT-II=Belhata-II.
SGT=Sagatha.
TKR=Tikura.

*The figures in parentheses show percentage out of Grand Total.

Table 5. Frequency of abrasion on the artifacts in each of the Lower Palaeolithic assemblage.

Abrasion	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Fresh	—	—	40	64.5	2	3.6	21	31.3	—	—	2	10	—	—	7	36.8
Slightly abraded	52	100	22	35.5	49	89.1	41	61.2	27	69.2	12	60	10	58.8	9	47.4
Moderately abraded	—	—	—	—	—	—	2	3	9	23.1	5	25	5	29.4	2	10.5
Heavily abraded	—	—	—	—	4	7.3	3	4.5	3	7.7	1	5	2	11.8	1	5.3
Total	52	100	62	100	55	100	67	100	39	100	20	100	17	100	19	100

Key :

ST-I = Sharda Temple-I.
ST-II = Sharda Temple-II.
ST-III = Sharda Temple-III.
ST-IV = Sharda Temple-IV.
NRH = Naru Hill.
BHT-II = Belhata-II.
SGT = Sagatha.
TKR = Tikura.

Table 6. Detailed inventory of the shaped tool classes recognised in each of the Lower Palaeolithic assemblage.

Tool Classes	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Choppers																
Side	—	—	—	—	1	100	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	1	100	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	1	100	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	1	100	—	—	—	—	—	—	—	—
Handaxes																
Ovate	3	50	5	35.7	3	25	3	75	2	33.3	—	—	—	—	2	100
Elongate ovate	—	—	1	7.1	—	—	—	—	—	—	—	—	—	—	—	—
Ovate accuminate	—	—	—	—	1	8.3	—	—	—	—	—	—	—	—	—	—
Limande	2	33.3	3	21.4	1	8.3	1	25	—	—	—	—	—	—	—	—
Double pointed	—	—	1	7.1	—	—	—	—	—	—	—	—	1	100	—	—
Lanceolate	—	—	1	7.1	—	—	—	—	—	—	—	—	—	—	—	—

Table 6. (Contd.)

Tool Classes	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Handaxes																
Sub-triangular	—	—	1	7.1	2	16.7	—	—	1	16.7	1	100	—	—	—	—
Cordiform	—	—	—	—	2	16.7	—	—	—	—	—	—	—	—	—	—
Untrimmed butt	1	16 7	2	14.3	3	25	—	—	3	50	—	—	—	—	—	—
Total	6	100	14	99.8	12	100	4	100	6	100	1	100	1	100	2	100
Cleavers																
Parallel	5	41.6	1	8.3	4	40	6	46.1	3	50	3	60	1	20	1	100
Divergent	6	50.0	2	16.7	1	10	5	38.5	1	16.7	1	20	1	20	—	—
Splayed	1	8 3	4	33.3	3	30	—	—	1	16.7	—	—	1	20	—	—
Convergent	—	—	5	41.6	2	20	2	15.4	1	16.7	1	20	2	40	—	—
Total	12	99.9	12	99.9	10	100	13	100	6	100.1	5	100	5	100	1	100
Knives																
Side	3	75	1	33.3	4	100	—	—	1	100	—	—	—	—	—	—
End and side	1	25	2	66.6	—	—	—	—	—	—	—	—	—	—	—	—
Total	4	100	3	99.9	4	100	—	—	1	100	—	—	—	—	—	—

Table 6. (Contd.)

Tool Classes	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Picks																
Convergent, round ended	1	100	1	100	—	—	—	—	—	—	—	—	—	—	—	—
Total	1	100	1	100	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces																
Butt end	3	100	1	100	1	100	4	50	—	—	3	100	—	—	—	—
Tip end	—	—	—	—	—	—	4	50	—	—	—	—	1	100	—	—
Total	3	100	1	100	1	100	8	100	—	—	3	100	1	100	—	—
Sub-spheroids	1	100	—	—	—	—	1	100	—	—	—	—	—	—	—	—
Total	1	100	—	—	—	—	1	100	—	—	—	—	—	—	—	—
Discoids	1	100	9	100	1	100	—	—	—	—	—	—	—	—	3	100
Total	1	100	9	100	1	100	—	—	—	—	—	—	—	—	3	100

Table 6. (Contd.)

Tool Classes	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Scrapers																
Single side	4	50	5	50	3	75	2	40	2	66.6	2	66.6	3	100	2	33.3
Double side	1	12.5	—	—	—	—	1	20	1	33.3	—	—	—	—	—	—
Three side	2	25	—	—	—	—	1	20	—	—	—	—	—	—	1	16.6
End	1	12 5	1	10	—	—	—	—	—	—	—	—	—	—	1	16 6
End and side	—	—	4	40	—	—	—	—	—	—	—	—	—	—	1	16 6
Circular	—	—	—	—	1	25	—	—	—	—	—	—	—	—	1	16.6
Angled	—	—	—	—	—	—	—	—	—	—	1	33.3	—	—	—	—
Core scraper	—	—	—	—	—	—	1	20	—	—	—	—	—	—	—	—
Total	8	100	10	100	4	100	5	100	3	99.9	3	99.9	3	100	6	99.7
Becs	1	100	—	—	—	—	1	100	—	—	—	—	—	—	—	—
Total	1	100	—	—	—	—	1	100	—	—	—	—	—	—	—	—
Grand Total	37		50		33		33		16		12		10		12	

Key :

ST-I=Sharda Temple-I.
ST-II=Sharda Temple-II.
ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV.

NRH=Naru Hill.
BHT-II=Belhata-II.
SGT=Sagatha.
TKR=Tikura.

Table 7. **Dimensions (cm) of artifacts from Sharda Temple-I.**

Artifacts	f	Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
		AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	6	12.8	1.65	.67	9.7	1.37	.55	5	1.47	.60	.76	,06	.02	.51	.09	.03	.38	.07	.02
Cleavers	12	12.9	1.67	.48	8.7	.78	.22	4.3	.58	.16	.67	.05	.01	.50	.07	.02	.33	.04	.01
Knives	4	12	1.21	.60	8.7	.83	.41	4.2	.85	.42	.72	.04	.02	.48	.08	.04	.35	.06	.03
Picks	1	16.3	0	0	10.3	0	0	4.4	0	0	—	—	—	—	—	—	—	—	—
Broken-bifaces	3	10.8	2.74	1.58	8.4	2 30	1.32	3.9	1.25	.72	.77	.02	.01	.48	.18	.10	.37	.14	.08
Sub-spheroids	1	12.3	0	0	11.4	0	0	9.8	0	0	.92	0	0	.85	0	0	.79	0	0
Discoids	1	12.7	0	0	11.4	0	0	6	0	0	.89	0	0	.52	0	0	.47	0	0
Scrapers	7	10.9	2.31	.87	10	2.67	1.0	4.2	1.12	.42	.92	.20	.07	.44	.14	.05	.39	.06	.02

Form No.—18

Table 7. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/Length AV	Width/Length SD	Width/Length SE	Thickness/Width AV	Thickness/Width SD	Thickness/Width SE	Thickness/Length AV	Thickness/Length SD	Thickness/Length SE
Becs	1	9	0	0	7.6	0	0	2.8	0	0	.84	0	0	,36	0	0	.31	0	0
Modified flakes	3	11	2.64	1.52	9	2.87	1.65	3.3	.96	.55	.80	.08	.04	.37	.03	.01	.30	·01	0
Modified chunks	3	13.1	1.55	.89	9,3	1.72	.99	5.1	1.22	.70	.71	.15	.08	,54	,04	,02	.39	.12	,06
Unmodified flakes	8	13	2.13	.75	9.5	1,58	.55	3.8	.56	.19	.74	.15	.05	.40	.08	.02	.29	.06	.02
Biface-trimming flakes	1	5.8	0	0	4.2	0	0	1.6	0	0	.72	0	0	,38	0	0	,27	0	0
Cores	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Key :

AV=Average. SE=Standard error,
SD=Standard deviation, f=Frequency.

Table 8. Statistical data on edge angle of tool classes from Sharda Temple-I.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	11	79.3	18.11	5.46
Cleavers	24	91	8.16	1.66
Knives	4	93.2	6.5	3.25
Picks	—	—	—	—
Broken-bifaces	4	95	16.87	8.43
Sub-spheroids	—	—	—	—
Discoids	—	—	—	—
Scrapers	11	89.8	10.93	3.29
Becs	—	—	—	—

Key :

n=Number of sides measured.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 9. Statistical data on flake angles of flakes and platform dimensions (cm) of flakes in each of the Lower Palaeolithic assemblage.

Site	Flake Angle				Platform						
					Height				Width		
	n	AV	SD	SE	n	AV	SD	SE	AV	SD	SE
Sharda Temple-I	8	119	7.4	2.61	8	3.6	2	.70	7	3.68	1.3
Sharda Temple-II	4	118	2 36	1.18	4	3.2	1.26	.63	5,9	2.99	1.49
Sharda Temple-III	14	115	7.3	1.95	14	3	1.44	.38	5.7	2.74	.73
Sharda Temple-IV	20	117	9.43	2.1	20	4.1	2.17	.48	6	2.62	58
Naru Hill	12	108	34.2	9.87	12	3	1.02	.29	7.3	2,12	.61
Belhata-II	2	116	2.82	1.99	2	2.2	.63	.44	5.50	4.59	3,24
Sagatha	2	126	2.12	1.49	2	3.5	2.61	1.84	6.3	4.73	3.34
Tikura	3	115	2.51	1.44	3	3	.55	.31	5,5	1.3	.75

Key :

n=Number of occurences.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 10. **Dimensions (cm) of artifacts from Sharda Temple-II.**

		Length			Width			Thickenss			Width/ Length			Thickness/ Width			Thickness/ Length		
Artifacts	f	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	14	11.2	1.93	.51	8.3	1.53	.40	4.1	.66	.17	.73	.07	.01	.50	.13	.03	.36	.06	.01
Cleavers	12	13.8	2.28	.65	8.8	1.41	.40	4.1	.89	.25	.64	.07	.02	.47	.11	.03	.27	.07	.02
Knives	3	12.4	1.21	.69	8.0	.89	.51	4.3	1.15	.66	.64	.07	.04	.54	.13	.07	.34	.06	.03
Picks	1	16.8	0	0	11.7	0	0	5	0	0	.69	0	0	.42	0	0	.29	0	0
Broken-bifaces	1	9.8	0	0	11.6	0	0	5.5	0	0	1.18	0	0	.47	0	0	.56	0	0
Sub-spheroids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Discoids	9	9.8	1.13	.37	8.8	.95	.31	5 5	1.0	.33	.89	.07	.02	.62	.10	.03	.51	.16	.05

Table 10. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/Length AV	Width/Length SD	Width/Length SE	Thickness/Width AV	Thickness/Width SD	Thickness/Width SE	Thickness/Length AV	Thickness/Length SD	Thickness/Length SE
Scrapers	10	11.6	1.65	.52	9.3	1.14	.36	4.5	1.32	.41	.80	.09	.02	.48	.10	.03	.39	.11	.03
Becs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modified flakes	2	11.1	0.21	.14	8.3	.14	.09	4.0	.63	·44	.74	.02	.01	.48	.08	.05	.36	.05	.03
Modified chunks	2	7.9	1.90	1.34	5.6	1.76	1.24	2.4	.63	.44	.70	.05	.03	.43	.02	.01	.30	0	0
Unmodified flakes	4	12.8	3.96	1.98	10.7	4.18	2.09	3.7	.75	.37	.81	.17	.08	.38	.11	.05	.29	.04	.02
Biface-trimming flakes	2	5.9	·56	.39	4.6	.56	.39	1.9	.21	.14	·77	.02	.01	.42	0	0	.33	0	0
Cores	2	16.3	.14	.09	14.1	.49	.34	6.3	1.41	.99	.86	.02	.01	.44	.08	.05	.38	.08	.05

Key :

AV=Average. SE=Standard error.
SD=Standard deviation. f=Frequency.

Table 11. Statistical data on edge angle of tool classes from Sharda Temple-II.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	26	80.4	11.66	2.28
Cleavers	18	80.7	10.65	2.51
Knives	3	79.3	4.61	2.66
Picks	—	—	—	—
Broken-bifaces	—	—	—	—
Sub-spheroids	—	—	—	—
Discoids	23	86.5	6.59	1.37
Scrapers	14	85.7	10.19	2.72
Becs	—	—	—	—

Key :

n=Number of sides measured.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 12. Dimensions (cm) of artifacts from Sharda Temple-III.

Artifacts	f	Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
		AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Coppers	1	12 8	0	0	10.3	0	0	7.3	0	0	.80	0	0	.70	0	0	.57	0	0
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	12	11.6	1.84	.53	8.4	.85	.24	4.8	1.16	.33	.73	.07	.02	.57	.14	.04	.42	.09	.02
Cleavers	10	12.1	2.35	.74	8.1	1.49	.47	4.0	.70	.22	.67	.10	.03	.49	.05	.01	.33	.05	.01
Knives	4	14.2	1.08	.54	9.6	2.07	1.03	4.3	.24	.12	.67	.09	.04	.46	.08	.04	.30	.02	.01
Picks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	1	10.2	0	0	8.5	0	0	4	0	0	.83	0	0	.47	0	0	.39	0	0
Sub-spheroids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Discoids	1	9.5	0	0	9	0	0	5.9	0	0	.94	0	0	.65	0	0	.62	0	0

Table 12. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/ Length AV	Width/ Length SD	Width/ Length SE	Thickness/ Width AV	Thickness/ Width SD	Thickness/ Width SE	Thickness/ Length AV	Thickness/ Length SD	Thickness/ Length SE
Scrapers	4	8.8	2.40	1 2	6.6	1.72	.86	3.0	1.25	.62	.75	.03	.01	.44	.08	.04	.33	.05	.02
Becs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modified flakes	4	9.4	.98	.49	7.9	.47	.23	3.6	.67	.33	.84	.06	.03	.45	.07	.03	.38	.03	.01
Modified chunks	1	10	0	0	7.6	0	0	3.5	0	0	.76	0	0	.46	0	0	.35	0	0
Unmodified flakes	10	10.4	2.92	.92	8.6	2.52	.79	4.1	1.27	.40	.83	.17	.05	.47	.07	.02	.39	.06	.01
Biface-trimming flakes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cores	3	15.2	.72	.41	9.9	2.35	1.35	6	1 21	.69	.64	.12	.06	.60	.02	.01	.39	.06	.03

Key :

AV=Average. SE=Standard error,

SD=Standard deviation, f=Frequency.

Form No.—19

Table 13. Statistical data on edge angle of tool classes from Sharda Temple-III.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	24	90.9	13.61	2.77
Cleavers	18	94.2	7.93	1.86
Knives	4	94.2	11.02	5.51
Picks	—	—	—	—
Broken-bifaces	—	—	—	—
Sub-spheroids	—	—	—	—
Discoids	—	—	—	—
Scrapers	6	87.5	7.79	3.18
Becs	—	—	—	—

Key :
n=Number of sides measursd.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 14: Dimensions (cm) of artifacts from Sharda Temple-IV.

		Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
Artifacts	f	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	1	13.2	0	0	12.3	0	0	5.3	0	0	.93	0	0	.43	0	0	.40	0	0
Handaxes	4	13.7	1.77	.88	10.5	1.37	.68	5.8	1.76	.88	.77	.05	.02	.57	.22	.11	.43	.15	.07
Cleavers	13	14.7	2.97	.82	9.5	1.89	.52	5	.80	.22	.65	.07	.01	.53	.10	.02	.33	.08	.02
Knives	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Picks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	7	10.8	2.98	1.12	9.5	1.54	.58	4.3	.66	.24	.91	.18	.06	.45	.04	.01	.41	.08	.03
Sub-spheroids	1	9.8	0	0	8.2	0	0	7.4	0	0	.83	0	0	.90	0	0	.75	0	0
Discoids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 14. (Contd.)

Artifacts	f	Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
		AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Scrapers	5	10.3	3.79	1.69	8.3	2 64	1.18	4.7	1.99	.88	.82	.21	.09	.55	.16	.07	.43	.09	.04
Becs	1	18	0	0	12	0	0	4.7	0	0	.66	0	0	.39	0	0	.26	0	0
Modified flakes	8	11.6	2.95	1.04	9	2.87	1.01	4.3	1.22	.43	.37	.03	.01	.48	.08	.02	.37	.03	.01
Modified chunks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmodified flakes	18	11.8	3.51	.82	10.2	2.74	.64	4	1.43	.33	.89	.20	.04	.40	.11	.02	.34	.08	.01
Biface-trimming flakes	5	7	1.15	.51	5.7	1.11	.49	2.4	1.03	.46	.81	.06	.02	.41	.10	.04	.34	.11	.04
Cores	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Key :

AV=Average.
SD=Standard deviation.
SE=Standard error.
f=Frequency.

Table 15. Statistical data on edge angle of tool classes from Sharda Temple-IV.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	6	74.7	27.75	11.32
Cleavers	26	93.3	14.38	2.82
Knives	—	—	—	—
Picks	—	—	—	—
Broken-bifaces	9	96.8	17.26	5.75
Sub-spheroids	—	—	—	—
Discoids	—	—	—	—
Scrapers	10	83.9	23.22	7.34
Becs	—	—	—	—

Key :

n=Number of sides measured.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 16. Dimensions (cm) of artifacts from Naru Hill.

		Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
Artifacts	f	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	6	12.7	2 95	1.2	9.9	2.73	1.11	5.3	.88	.35	.77	.09	.03	.56	.14	.05	.44	.12	.04
Cleavers	6	11.8	1.73	.70	8.3	1.21	.49	4.4	.68	.27	.71	.14	.05	.54	.08	.03	.38	.07	.02
Knives	1	12.5	0	0	9 3	0	0	3.8	0	0	.74	0	0	.40	0	0	.30	0	0
Picks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sub-spheroids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Discoids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 16. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/Length AV	Width/Length SD	Width/Length SE	Thickness/Width AV	Thickness/Width SD	Thickness/Width SE	Thickness/Length AV	Thickness/Length SD	Thickness/Length SE
Scrapers	1	16.2	0	0	10.3	0	0	4.4	0	0	.63	0	0	.42	0	0	.27	0	0
Becs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modified flakes	1	13.4	0	0	12	0	0	6.5	0	0	.89	0	0	.54	0	0	.48	0	0
Modified chunks	8	11.6	2.12	.74	9.1	1.72	.60	5.1	1.78	.62	.79	.12	.04	.54	.13	.04	.42	.10	.03
Unmodified flakes	11	12	1.59	.47	11.3	2 62	.78	4.3	.86	.25	.96	.28	.08	.39	.10	.03	.35	07	.02
Biface-trimming flakes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cores	1	11	0	0	11.6	0	0	6	0	0	1.05	0	0	.51	0	0	.54	0	0

Key :
AV=Average.
SD=Standard deviation.
SE=Standard error.
f=Frequency.

Table 17. Statistical data on edge angle of tool classes from Naru Hill.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	9	87.8	18.1	6.03
Cleavers	7	98.4	11.02	4.16
Knives	1	82	0	0
Picks	—	—	—	—
Broken-bifaces	—	—	—	—
Sub-spheroids	—	—	—	—
Discoids	—	—	—	—
Scrapers	—	—	—	—
Becs	—	—	—	—

Key :

n=Number of sides measured.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 18. Dimensions (cm) of artifacts from Belhata-II.

Artifacts		Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
	f	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	1	13.5	0	0	9.2	0	0	4.5	0	0	.68	0	0	.48	0	0	.33	0	0
Cleavers	5	13.6	1.46	.65	9.3	.19	.08	4.8	.28	.12	.69	.07	.03	0.50	.02	0	.35	.04	.01
Knives	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Picks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	3	10·4	.60	.34	8.5	.62	.35	4.5	.61	.35	.81	.07	.04	.53	.11	.06	.43	.05	.02
Sub-spheroids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Discoids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Scrapers	2	9.2	3.39	2.39	8.3	3.04	2.14	4	2.05	1.44	.9	0	0	.47	.07	.04	.42	.06	.04

Form No.—20

Table 18. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/ Length AV	Width/ Length SD	Width/ Length SE	Thickness/ Width AV	Thickness/ Width SD	Thickness/ Width SE	Thickness/ Length AV	Thickness/ Length SD	Thickness/ Length SE
Becs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modified flakes	1	8.3	0	0	5.7	0	0	3.6	0	0	.68	0	0	.63	0	0	.43	0	0
Modified-chunks	2	9.6	1.2	.84	7	.77	.54	4.2	1.20	.84	.73	.01	0	.59	.10	.07	.43	.07	.04
Unmodified flakes	2	12.2	1.27	.89	7.8	.28	.19	3.8	.42	.29	.64	.09	.06	.48	03	.02	.31	.06	.04
Biface-trimming flakes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cores	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Key :

AV=Average. SE=Standard error.
SD=Standard deviation. f=Frequency.

Table 19 **Statistical data on edge angle of tool classes from Belhata-II.**

Tool Classes	Edge Angle			
	n	Av	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	2	79.5	3.53	2.49
Cleavers	9	91.9	6.9	2.3
Knives	—	—	—	—
Picks	—	—	—	—
Broken-bifaces	1	90	0	0
Sub-spheroids	—	—	—	—
Discoids	—	—	—	—
Scrapers	4	95.2	3.5	1.75
Becs	—	—	—	—

Key :

n = Number of sides measured.
AV = Average.
SD = Standard deviation.
SE = Standard error.

Table 20. Dimensions (cm) of artifacts from Sagatha.

Artifacts	f	Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
		AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	1	14.5	0	0	10.5	0	0	4.5	0	0	.72	0	0	.42	0	0	.31	0	0
Cleavers	5	12.8	1.31	.58	9.4	1.11	.49	4.5	.45	.20	.73	.08	.03	.48	.08	.03	.35	.04	.01
Knives	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Picks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	1	7.3	0	0	8.2	0	0	2.7	0	0	1.12	0	0	.32	0	0	.36	0	0
Sub-spheroids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Discoids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 20. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/Length AV	Width/Length SD	Width/Length SE	Thickness/Width AV	Thickness/Width SD	Thickness/Width SE	Thickness/Length AV	Thickness/Length SD	Thickness/Length SE
Scrapers	3	12.4	2.51	1.44	9.4	.37	.21	4.8	.85	.49	.77	.15	.08	.51	.07	.04	.39	.07	.04
Becs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modified flakes	1	14.6	0	0	8.2	0	0	5.5	0	0	.56	0	0	.67	0	0	.37	0	0
Modified chunks	2	8.8	.42	.29	7.5	1.20	.84	5.2	1.13	.79	.78	.09	.06	.68	.04	.02	.58	.10	.07
Unmodified flakes	2	10.2	4.24	2.99	8.4	1 41	.99	6.4	2.68	1.89	.86	.22	.15	.74	.19	.13	.62	0	0
Biface-trimming flakes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cores	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Key :

AV=Average. SE=Standard error.
SD=Standard deviation. f=Frequency.

Table 21. Statistical data on edge angle of tool classes from Sagatha.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	—	—	—	—
Cleavers	8	87.6	9.53	3.36
Knives	—	—	—	—
Picks	—	—	—	—
Broken-bifaces	—	—	—	—
Sub-spheroids	—	—	—	—
Discoids	—	—	—	—
Scrapers	3	99	3.45	1.99
Becs	—	—	—	—

Key :

n = Number of sides measured.
AV = Average.
SD = Standard deviation.
SE = Standard error.

Table 22. Dimensions (cm) of artifacts from Tikura.

Artifacts		Length			Width			Thickness			Width/ Length			Thickness/ Width			Thickness/ Length		
	f	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE	AV	SD	SE
Choppers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Proto-handaxes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Handaxes	2	11.4	.56	.39	9.7	.98	.69	5.4	1.62	1.14	.84	.04	.02	.57	.22	.15	.48	.16	.11
Cleavers	1	12.5	0	0	8.5	0	0	3.6	0	0	.68	0	0	.42	0	0	.28	0	0
Knives	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Picks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sub-spheroids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Discoids	3	7.9	1.30	.75	6.5	1.28	.73	4.1	1.19	.68	.82	.06	.03	.63	.18	.10	.51	.10	.05
Scrapers	6	10.1	2.28	.93	7.4	1.95	.79	4.4	1.43	.58	.73	.09	.03	.59	.18	.07	.44	.15	.06

Table 22. (Contd.)

Artifacts	f	Length AV	Length SD	Length SE	Width AV	Width SD	Width SE	Thickness AV	Thickness SD	Thickness SE	Width/Length AV	Width/Length SD	Width/Length SE	Thickness/Width AV	Thickness/Width SD	Thickness/Width SE	Thickness/Length AV	Thickness/Length SD	Thickness/Length SE
Becs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modified flakes	2	11.4	2.26	1.59	8.9	.28	.19	4.2	.35	.24	.79	.18	.12	.47	.05	.03	.37	04	.02
Modified chunks	2	10.3	2.26	1.59	9.1	1.90	1 34	4.5	1.4[illegible]	1.04	.88	.01	0	.49	.05	.03	.43	.04	.02
Unmodified flakes	3	11.2	3.3	1.9	8.8	3.03	1.74	3.7	1.22	.70	.78	.20	.11	.44	.14	.08	.33	.03	01
Biface-trimming flakes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cores	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Key :

AV = Average.
SD = Standard deviation.
SE = Standard error.
f = Frequency.

Table 23. Statistical data on edge angle of tool classes from Tikura.

Tool Classes	Edge Angle			
	n	AV	SD	SE
Choppers	—	—	—	—
Proto-handaxes	—	—	—	—
Handaxes	4	93	9.05	4 52
Cleavers	2	92.5	14.84	10.49
Knives	—	—	—	—
Picks	—	—	—	—
Broken-bifaces	—	—	—	—
Sub-spheroids	—	—	—	—
Discoids	9	95.5	12.66	4.22
Scrapers	9	90	11.24	3.76
Becs	—	—	—	—

Key :

n=Number of sides measured.
AV=Average.
SD=Standard deviation.
SE=Standard error.

Table 24. Frequency of primary forms of shaped tools in each of the Lower Palaeolithic assemblage.

Primary Forms	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Side flakes	9	24.3	9	18	7	21.2	4	12.1	2	12 5	2	16.7	—	—	—	—
End flakes	12	32.4	10	20	9	27.3	15	45.4	6	37.5	3	25	1	10	4	33.3
Cores	—	—	—	—	—	—	1	3	—	—	—	—	1	10	—	—
Chunks	8	21.6	17	34	6	18.2	4	12.1	6	37.5	4	33.3	4	40	7	58.3
Cobble/Pebbles	—	—	2	4	3	9.1	—	—	—	—	—	—	1	10	1	8.3
Indeterminates	8	21 6	12	24	8	24.2	9	27.3	2	12 5	3	25	3	30	—	—
Total	37	99.9	50	100	33	100	33	99.9	16	100	12	100	10	100	12	99.9

Key :

ST-I=Sharda Temple-I. ST-II=Sharda Temple-II ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV. NRH=Naru Hill. BHT-II=Belhata.
SGT=Sagatha. TKR=Tikura. n=Number of occurences.

Table 25. Frequency of cross-sections of shaped tools in each of the Lower Palaeolithic assemblage.

Cross-Sections	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%		%	n	%
1	3	8 1	7	14	7	21.2	3	9.1	1	6.2	—	—	1	10	—	—
2	1	2.7	1	2	—	—	1	3	—	—	1	8.3	—	—	—	—
3	5	13.5	9	18	3	9.1	5	15.1	2	12.5	4	33.3	1	10	3	25
4	5	13.5	1	2	1	3	3	9.1	1	6.2	—	—	2	20	—	—
5	2	5.4	3	6	—	—	—	—	—	—	—	—	—	—	—	—
6	3	8.1	7	14	6	18.2	3	9.1	2	12.5	3	25	1	10	2	16.7
7	9	24.3	11	22	11	33.3	9	27.3	8	50	2	16.7	3	30	3	25
8	—	—	1	2	—	—	1	3	1	6.2	—	—	—	—	3	25
9	3	8.1	—	—	—	—	3	9.1	—	—	1	8.3	—	—	—	—

Table 25. (Contd.)

Cross-Sections	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
10	1	2.7	5	10	2	6.1	2	6.1	—	—	1	8.3	2	20	1	8.3
11	5	13.5	5	10	3	9.1	3	9.1	1	6.2	—	—	—	—	—	—
Total	37	99.9	50	100	33	100	33	100	16	99.8	12	99.9	10	100	12	100

Key :

1=Biconvex. =Lanticular. 3=Planoconvex-high back.
4=Planoconvex-low back. 5=Triangular. 6=Sub triangular.
7=Trapezoid. 8=Rhomboid. 9=Parallelogram.
10=Irregular quadrilateral. 11=Polygon.
ST-I=Sharda Temple-I. ST-II=Sharda Temple-II. ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV. NRH=Naru Hill. BHT-II=Belhata-II.
SGT=Sagatha. TKR=Tikura.

Table 26. **Frequency of cortex groups of shaped tools in each of the Lower Palaeolithic assemblage.**

Percentage of Cortex	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50—100	12	32.4	6	12	11	33.3	4	12.1	7	43.7	1	8.3	9	90	1	8.3
0—50	15	40.5	28	56	13	39.4	10	30.3	8	50	11	91.7	1	10	8	66.7
0	10	27	16	32	9	27.3	19	57.6	1	6.2	—	—	—	—	3	25
Total	37	99.9	50	100	33	100	33	100	16	99.9	12	100	10	100	12	100

Key :

ST-I=Sharda Temple-I.
ST-II=Sharda Temple-II.
ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV.
NRH=Naru Hill.
BHT-II=Belhata-II.
SGT=Sagatha.
TKR=Tikura.

Table 27. Frequency of plan forms of flakes in each of the Lower Palaeolithic assemblage.

Plan Forms	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	1	12.5	—	—	6	42.8	3	14.3	1	7.7	—	—	1	50	1	33.3
2	2	25	2	50	3	21.4	3	14.3	3	23.1	2	66.6	—	—	—	—
3	—	—	—	—	—	—	3	14.3	2	15.4	—	—	—	—	1	33.3
4	—	—	1	25	—	—	1	4.8	1	7.7	—	—	—	—	—	—
5	2	25	—	—	2	14.3	3	14.3	1	7.7	—	—	1	50	—	—
6	3	37.5	1	25	1	7.1	5	23.8	3	23.1	—	—	—	—	1	33.3
7	—	—	—	—	2	14.3	3	14.3	2	15.4	1	33.3	—	—	—	—
Total	8	100	4	100	14	99.9	21	100.1	13	100.1	3	99.9	2	100	3	99.9

Key :

1=Short quadrilateral. 2=Long quadrilateral. 3=Short triangular. 4=Long triangular.
5=Short irregular. 6=Long irregular. 7=Elliptical.

ST-I=Sharda Temple I ST-II=Sharda Temple-II ST-III=Sharda Temple-III
ST-IV=Sharda Temple-IV NRH=Naru Hill BHT-II=Belhata-II
SGT=Sagatha. TKR=Tikura.

Table 28. Frequency of tool classes of main tool kits in each of the Lower Palaeolithic assemblage.

Tool Kits	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%*	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Handaxes	6	16.2	14	28	12	36.4	4	12.1	6	37.5	1	8.3	1	10	2	16.7
Cleavers	12	32.4	12	24	10	30.3	13	39.4	6	37.5	5	41.7	5	50	1	8.3
Knives	4	10.8	3	6	4	12.1	—	—	1	6.2	—	—	—	—	—	—
Scrapers	8	21.6	10	20	4	12.1	5	15.1	3	18.7	3	25	3	30	6	50
Total	30	81	39	78	30	90.9	22	66.6	16	99.9	9	75	9	90	9	75
Shaped Tools	37	(71.1)**	50	(80.6)	33	(60)	33	(49.2)	16	(41)	12	(60)	10	(58.8)	12	(63.1)

Key :

ST-I=Sharda Temple-I. ST-II=Sharda Temple-II. ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV. NRH=Naru Hill. BHT-II=Belhata-II.
SGT=Sagatha. TKR=Tikura.

*Percentage out of Shaped Tools.

**The figures in parentheses show percentage out of Total Artifacts.

Table 29. Detailed inventory of the tool types recognized in each of the Lower Palaeolithic assemblage.

No./Tool Types	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Choppers																
1. Side	—	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—
2. *Proto-Handaxes*	—	—	—	—	—	—	1	3	—	—	—	—	—	—	—	—
Handaxes																
3. Ovate	3	8.1	5	10	3	9.1	3	9.1	2	12.5	—	—	—	10	2	16.7
4. Elongate ovate	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—
5. Ovate accuminate	—	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—
6. Limande	2	5.4	3	6	1	3	1	3	—	—	—	—	1	10	—	—
7. Double pointed	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—
8. Lanceolate	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—
9. Sub-triangular	—	—	1	2	2	6.1	—	—	1	6.2	1	8.3	—	—	—	—
10. Cordiform	—	—	—	—	2	6.1	—	—	—	—	—	—	—	—	—	—
11. Untrimmed butt	1	2.7	2	4	3	9 1	—	—	3	18.7	—	—	—	—	—	—

Table 29. (Contd.)

No./Tool Types	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Cleavers																
12. Parallel	5	13.5	1	2	4	12.1	6	18.2	3	18.7	3	25	1	10	1	8.3
13. Divergent	6	16.2	2	4	1	3	5	15.1	1	6.2	1	8.3	1	10	—	—
14. Splayed	1	2.7	4	8	3	9.1	—	—	1	6.2	—	—	1	10	—	—
15. Convergent	—	—	5	10	2	6.1	2	6.1	1	6.2	1	8.3	2	20	—	—
Knives																
16. Side	3	8.1	1	2	4	12.1	—	—	1	6.2	—	—	—	—	—	—
17. End and side	1	2.7	2	4	—	—	—	—	—	—	—	—	—	—	—	—
Picks																
18 Convergent, round ended	1	2.7	1	2	—	—	—	—	—	—	—	—	—	—	—	—
Broken-bifaces																
19 Butt end	3	8.1	1	2	1	3	4	12.1	—	—	3	25	—	—	—	—

Table 29. (Contd.)

No./Tool Types	ST-I		ST-II		ST-III		ST-IV		NRH		BHT-II		SGT		TKR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
20. Tip end	—	—	—	—	—	—	4	12.1	—	—	—	—	1	10	—	—
21. *Sub-spheroids*	1	2.7	—	—	—	—	1	3	—	—	—	—	—	—	—	—
22. *Discoids*	1	2.7	9	18	1	3	—	—	—	—	—	—	—	—	3	25
Scrapers																
23. Single side	4	10.8	5	10	3	9.1	2	6.1	2	12.5	2	16.7	3	30	2	16.7
24. Double side	1	2.7	—	—	—	—	1	3	1	6.2	—	—	—	—	—	—
25. Three side	2	5.4	—	—	—	—	1	3	—	—	—	—	—	—	1	8.3
26. End	1	2.7	1	2	—	—	—	—	—	—	—	—	—	—	1	8.3
27. End and side	—	—	4	8	—	—	—	—	—	—	—	—	—	—	1	8.3
28. Circular	—	—	—	—	1	3	—	—	—	—	1	8.3	—	—	—	—
29. Angled	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30. Core scraper	—	—	—	—	—	—	1	3	—	—	—	—	—	—	—	—
31. *Becs*	1	2.7	—	—	—	—	1	3	—	—	—	—	—	—	—	—

Key :

ST-I=Sharda Temple-I.
ST-II=Sharda Temple-II.
ST-III=Sharda Temple-III.
ST-IV=Sharda Temple-IV.

NRH=Naru Hill.
BHT-II=Belhata-II.
SGT=Sagatha.
TKR=Tikura.

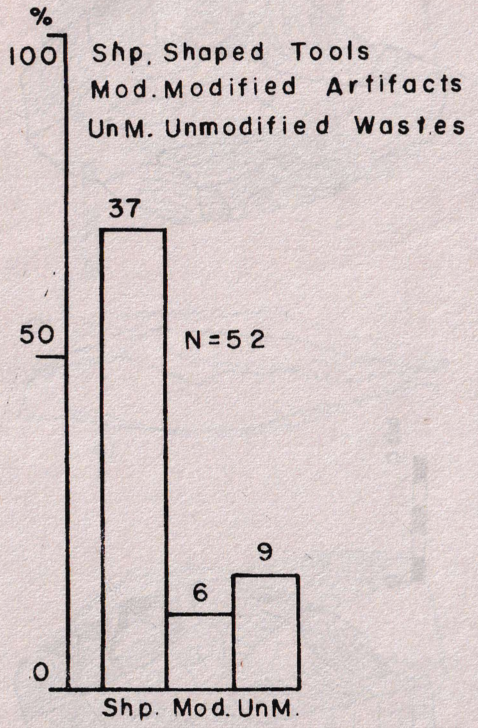

Figure 52. Histogram of main artifacts groups : Sharda Temple-I.

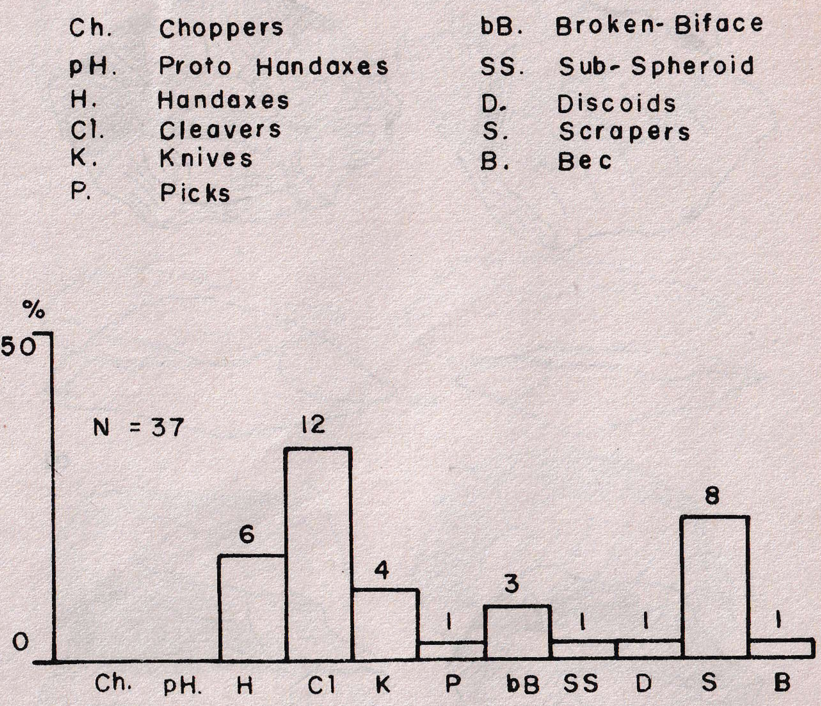

Figure 53. Histogram of shaped tools : Sharda Temple-I.

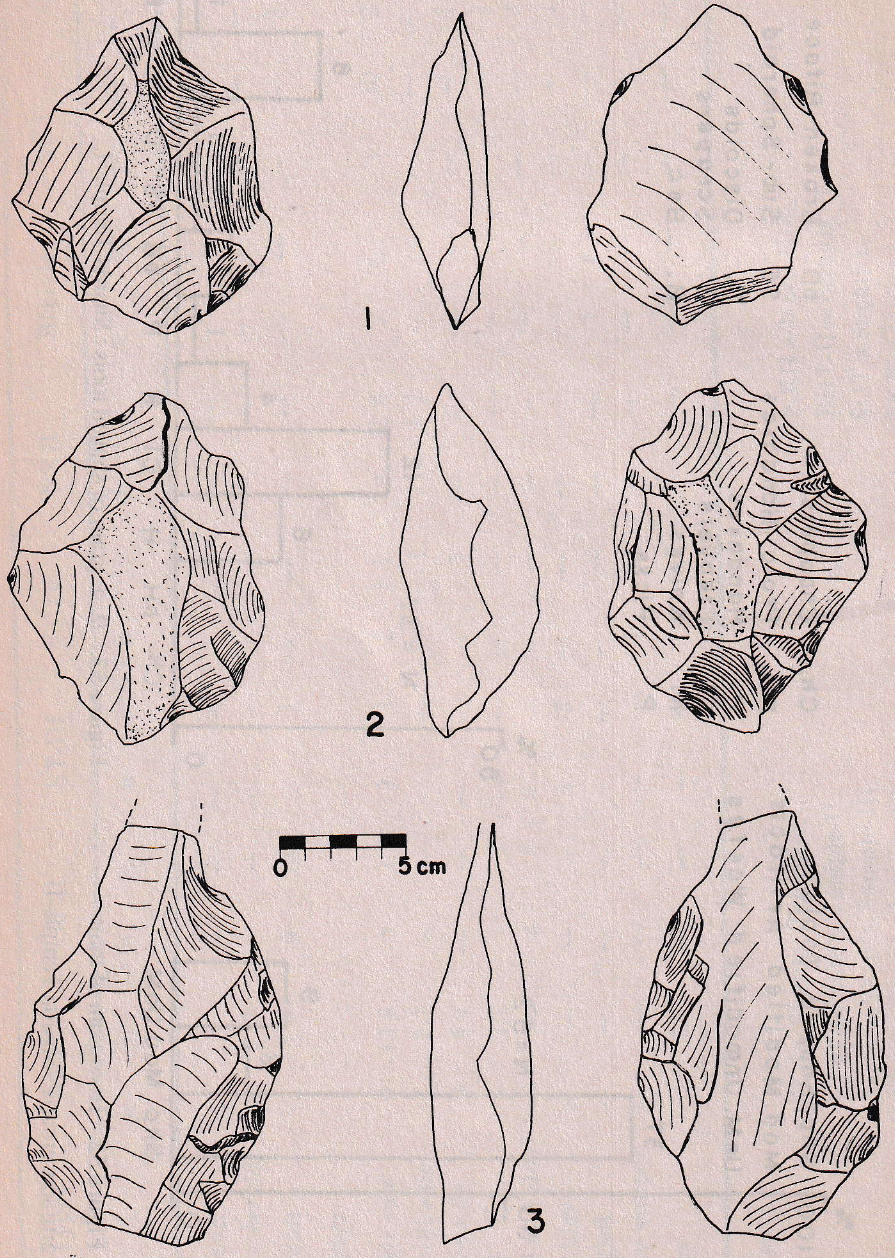

Figure 54. Artifact drawings : Sharda Temple-I.

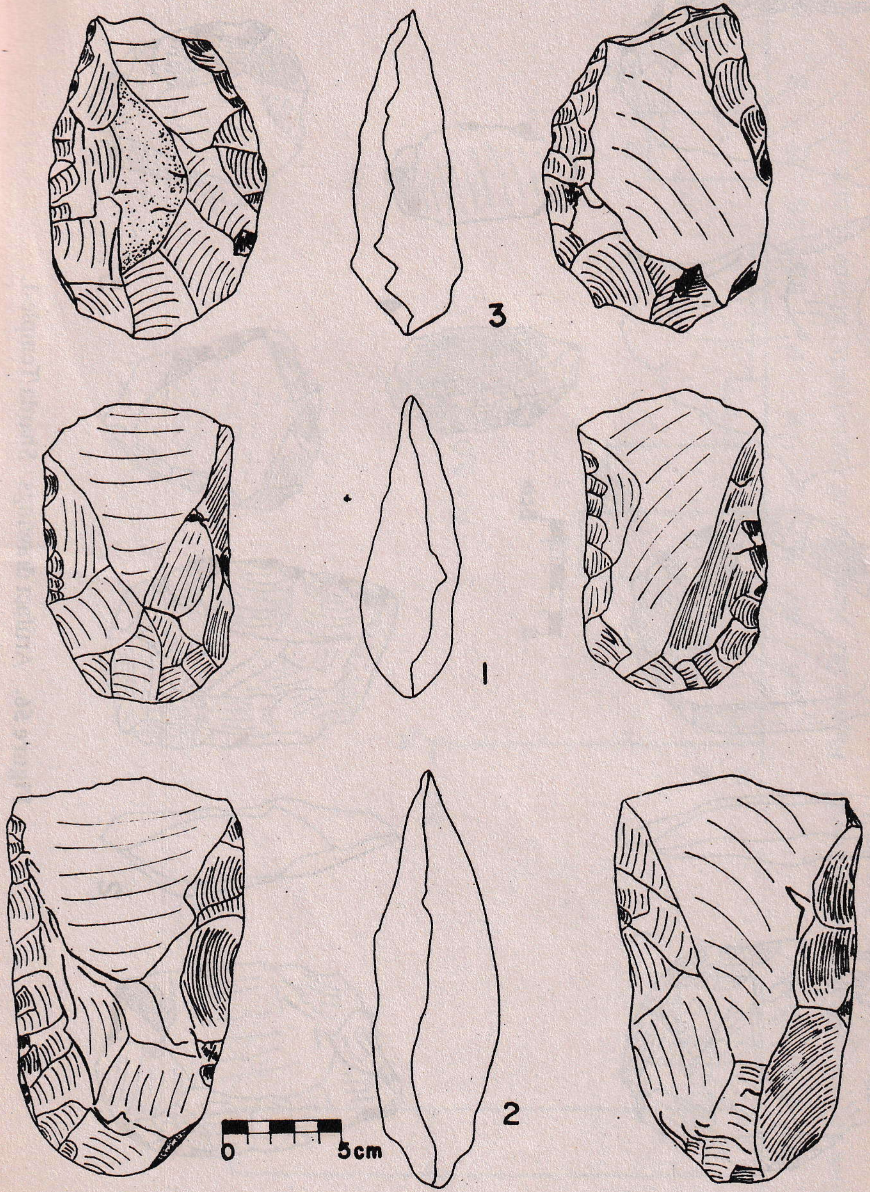

Figure 55. Artifact drawings : Sharda Temple-I.

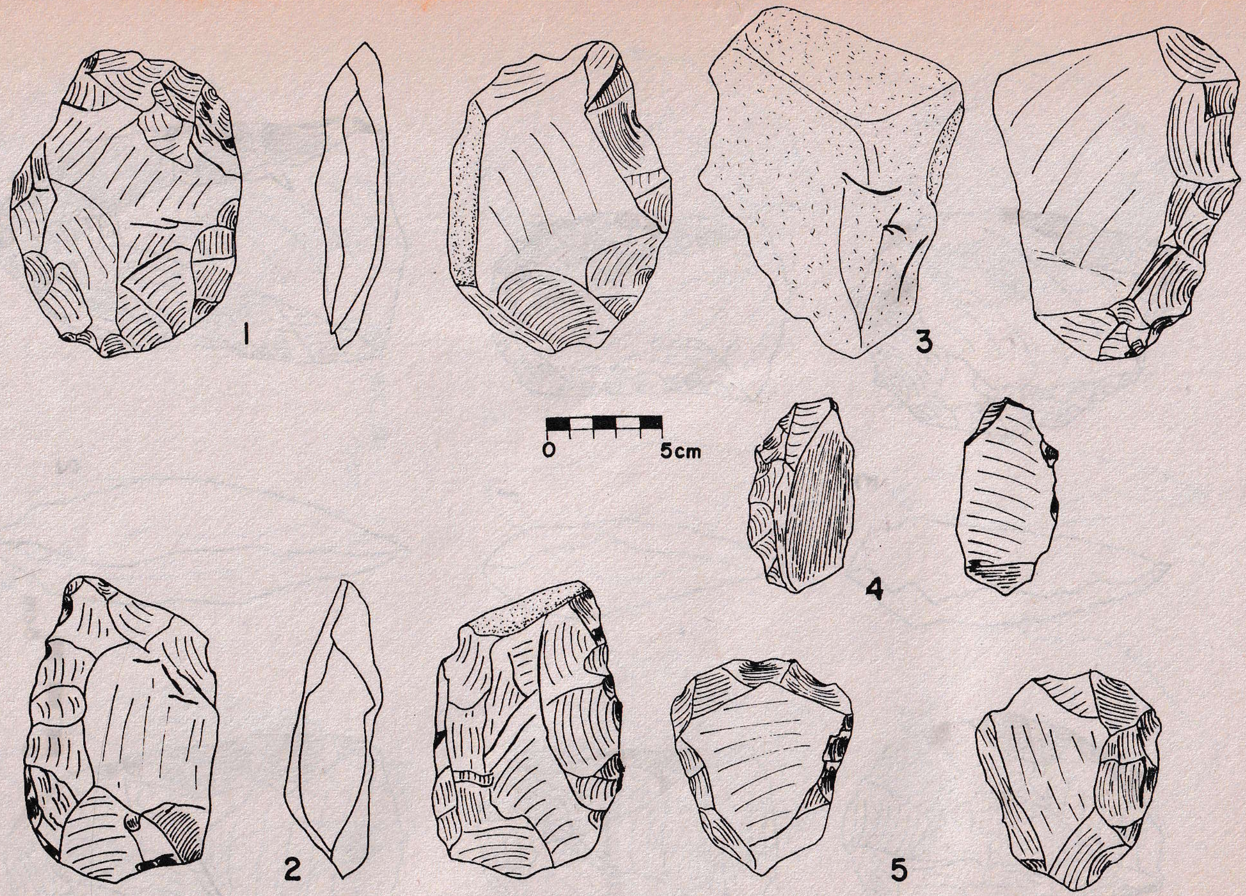

Figure 56. Artifact drawings : Sharda Temple-I.

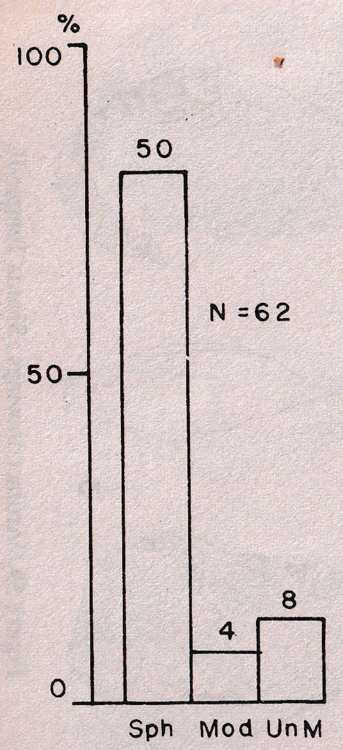

Figure 57. Histogram of main artifacts groups : Sharda Temple-II.

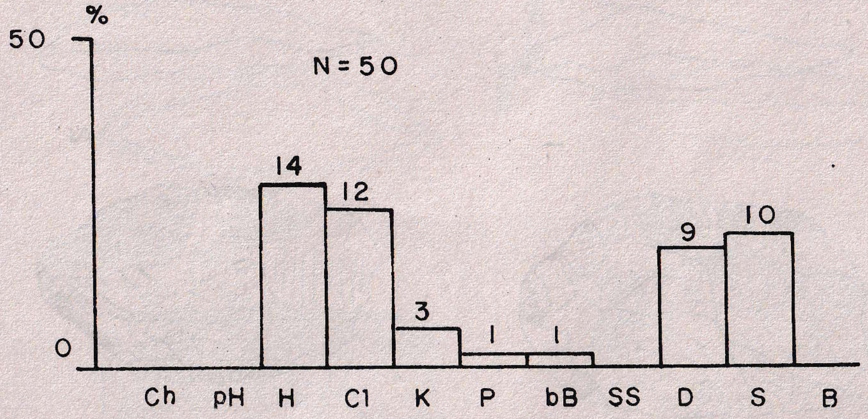

Figure 58. Histogram of shaped tools : Sharda Temple-II.

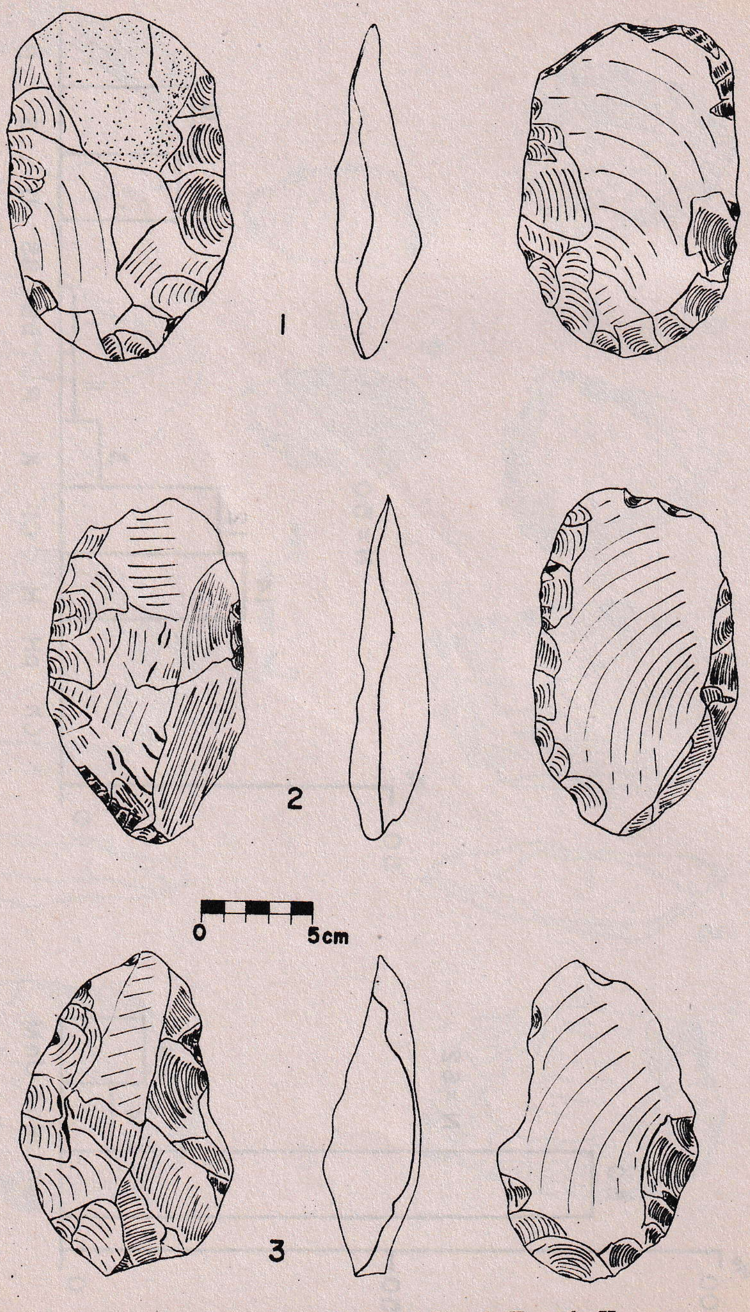

Figure 59. Artifact drawings : Sharda Temple-II.

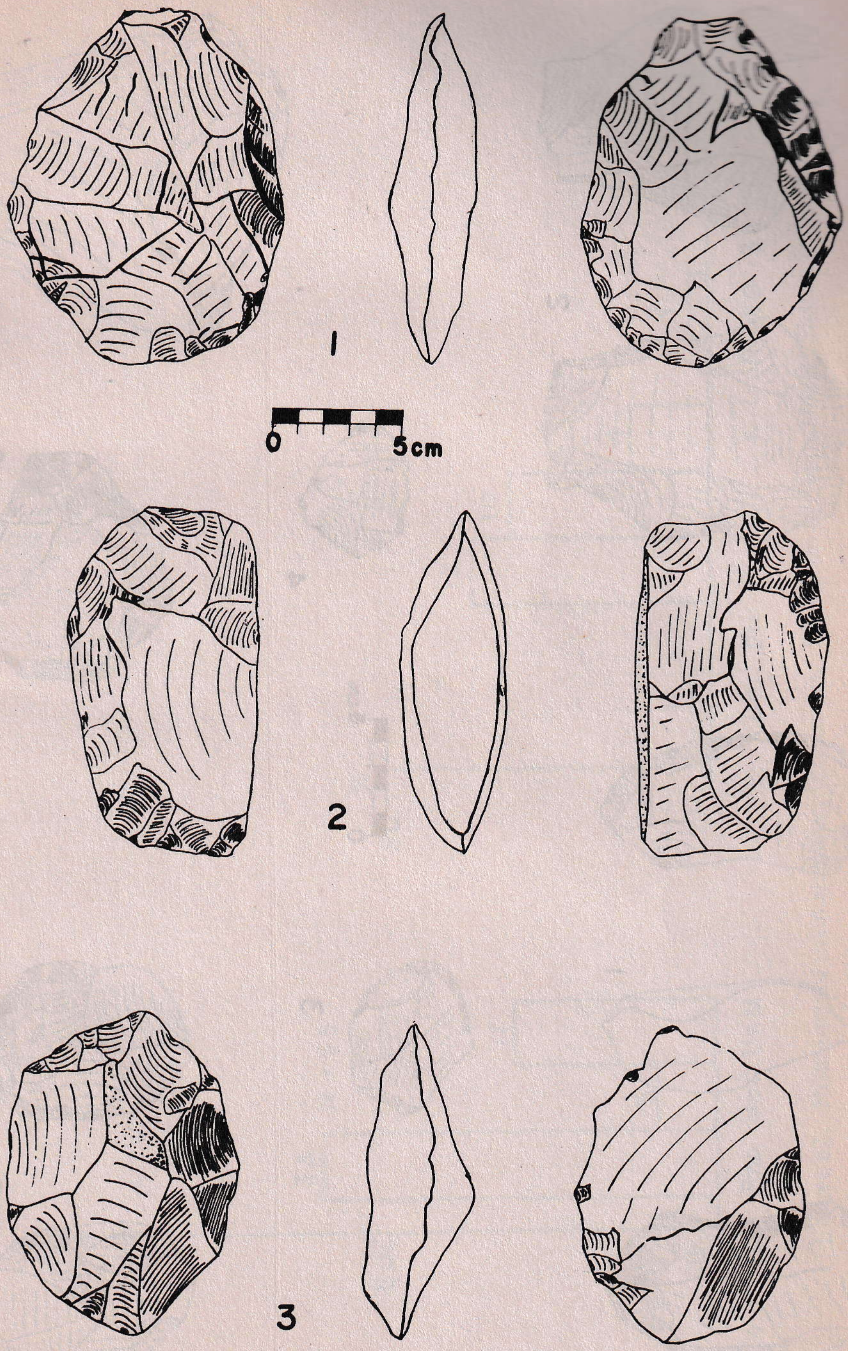

Figure 60. Artifact drawings : Sharda Temple-II.

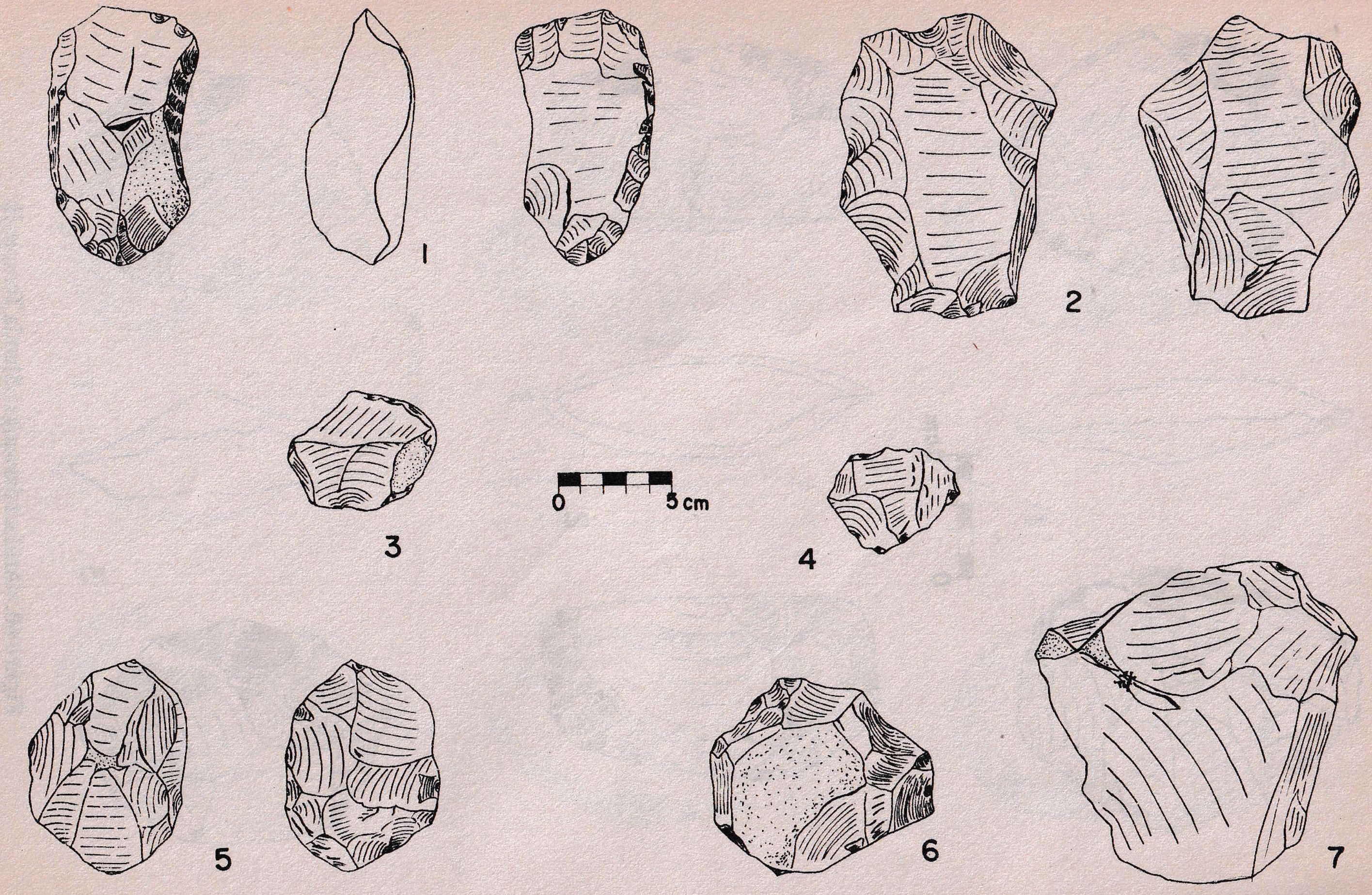

Figure 61. Artifact drawings : Sharda Temple-II.

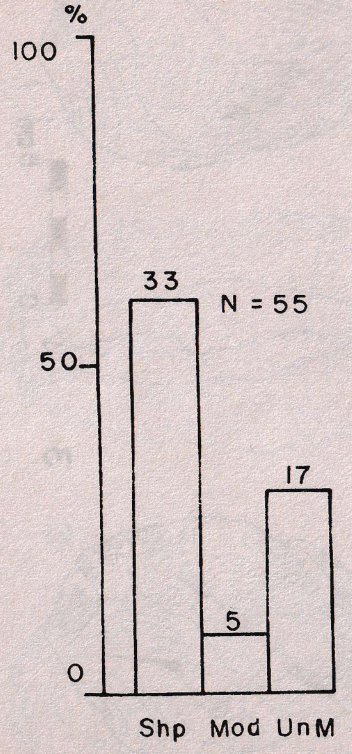

Figure 62. Histogram of main artifacts groups : Sharda Temple-III.

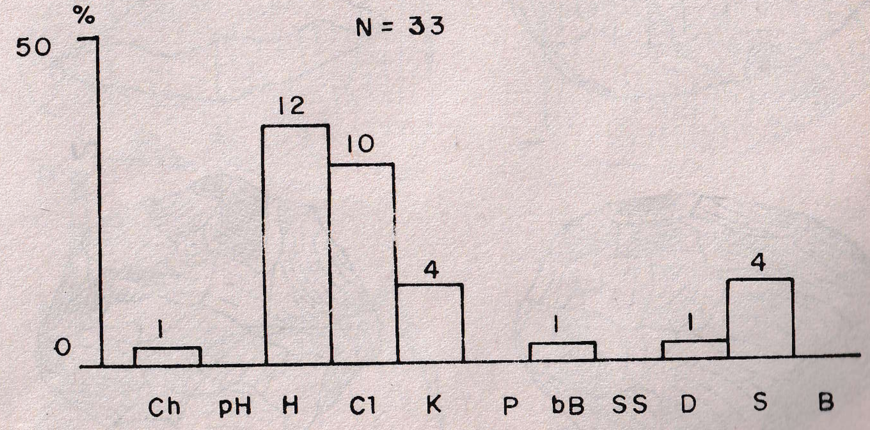

Figure 63. Histogram of Shaped tools : Sharda Temple-III.

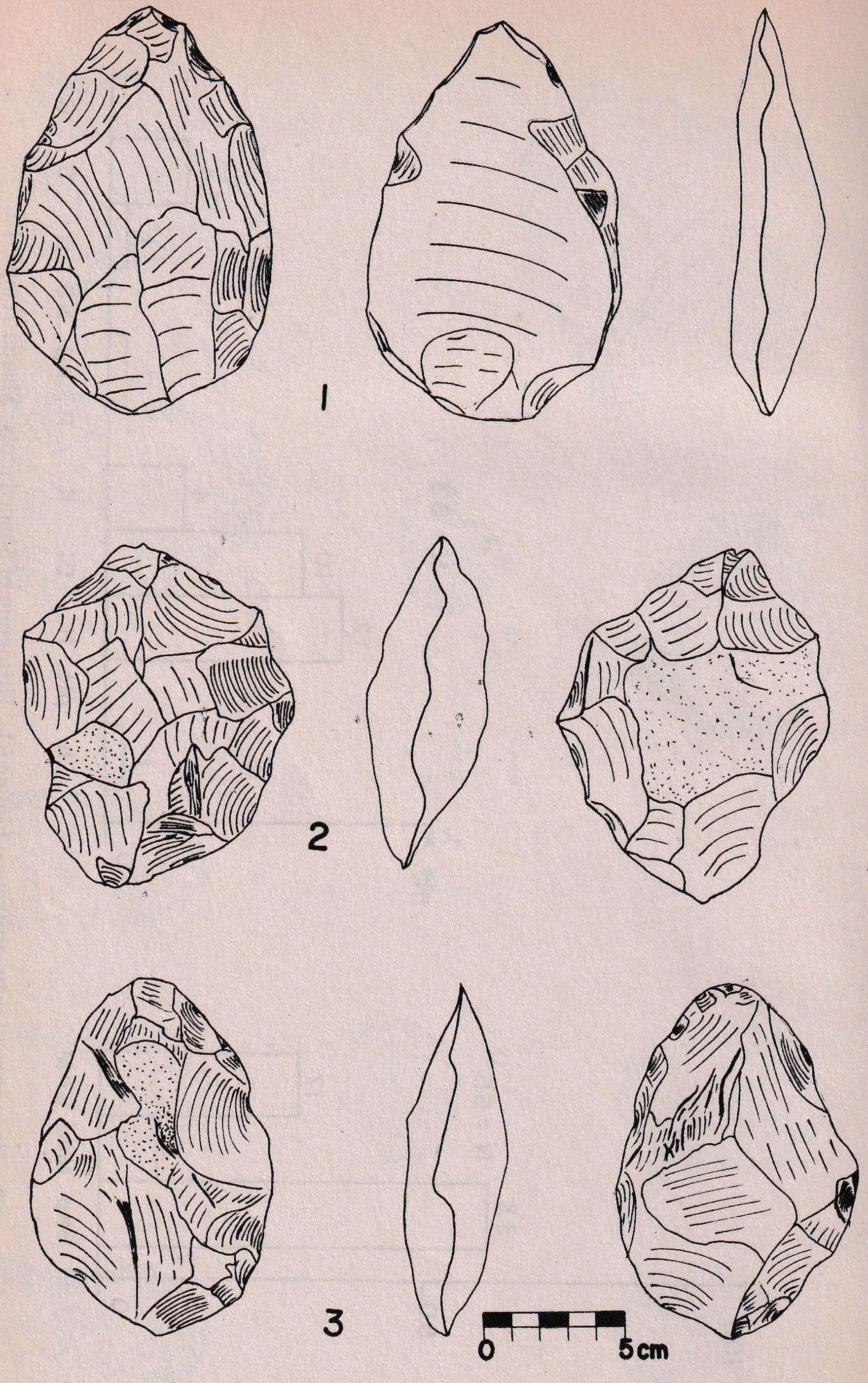

Figure 64. Artifact drawings : Sharda Temple-III.

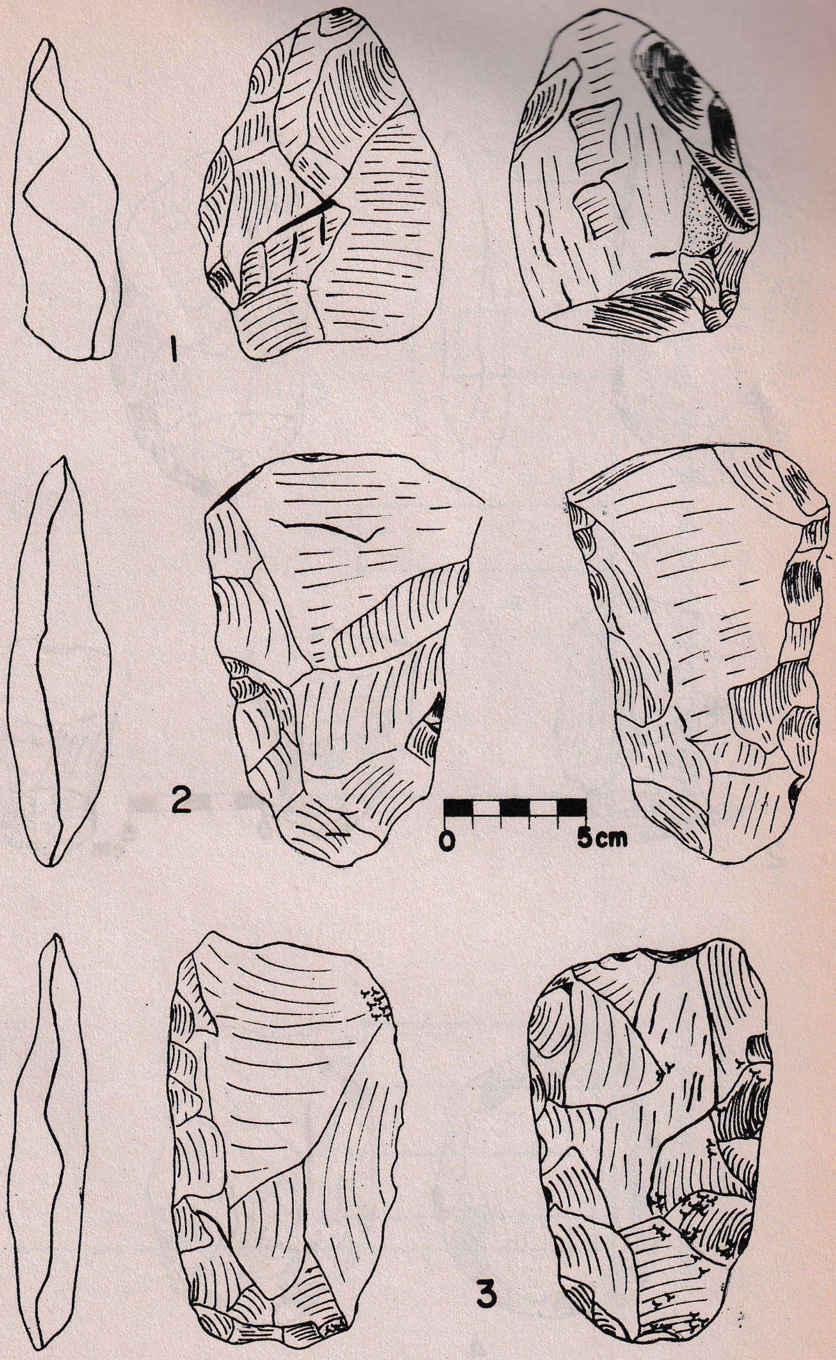

Figure 65. Artifact drawings : Sharda Temple-III.

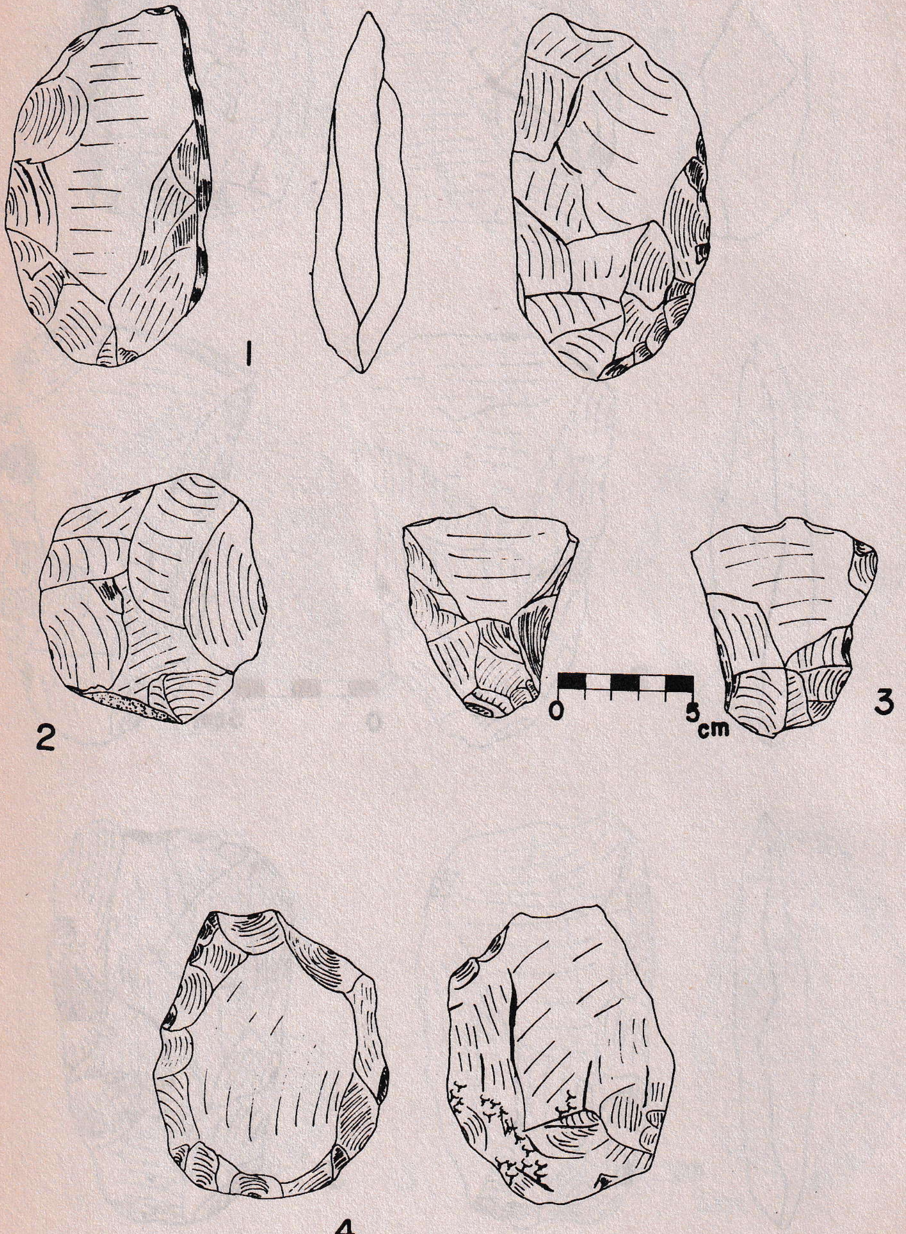

Figure 66. Artifact drawings : Sharda Temple-III.

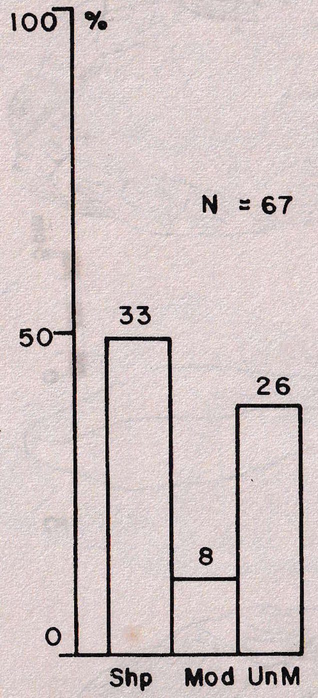

Figure 67. Histogram of main artifacts groups : Sharda Temple-IV.

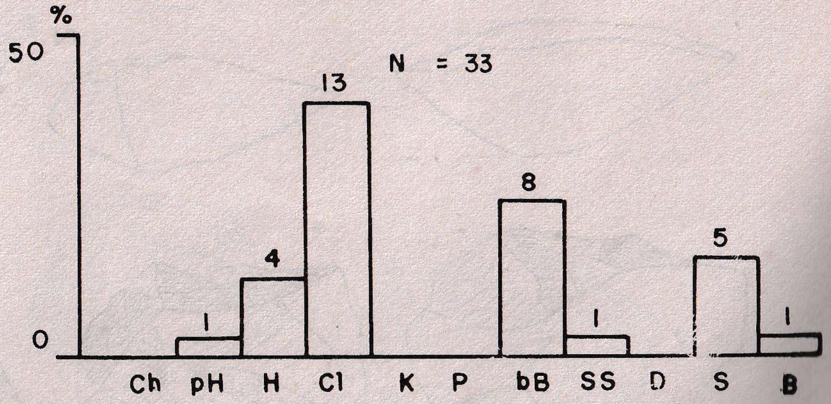

Figure 68. Histogram of shaped tools : Sharda Temple-IV.

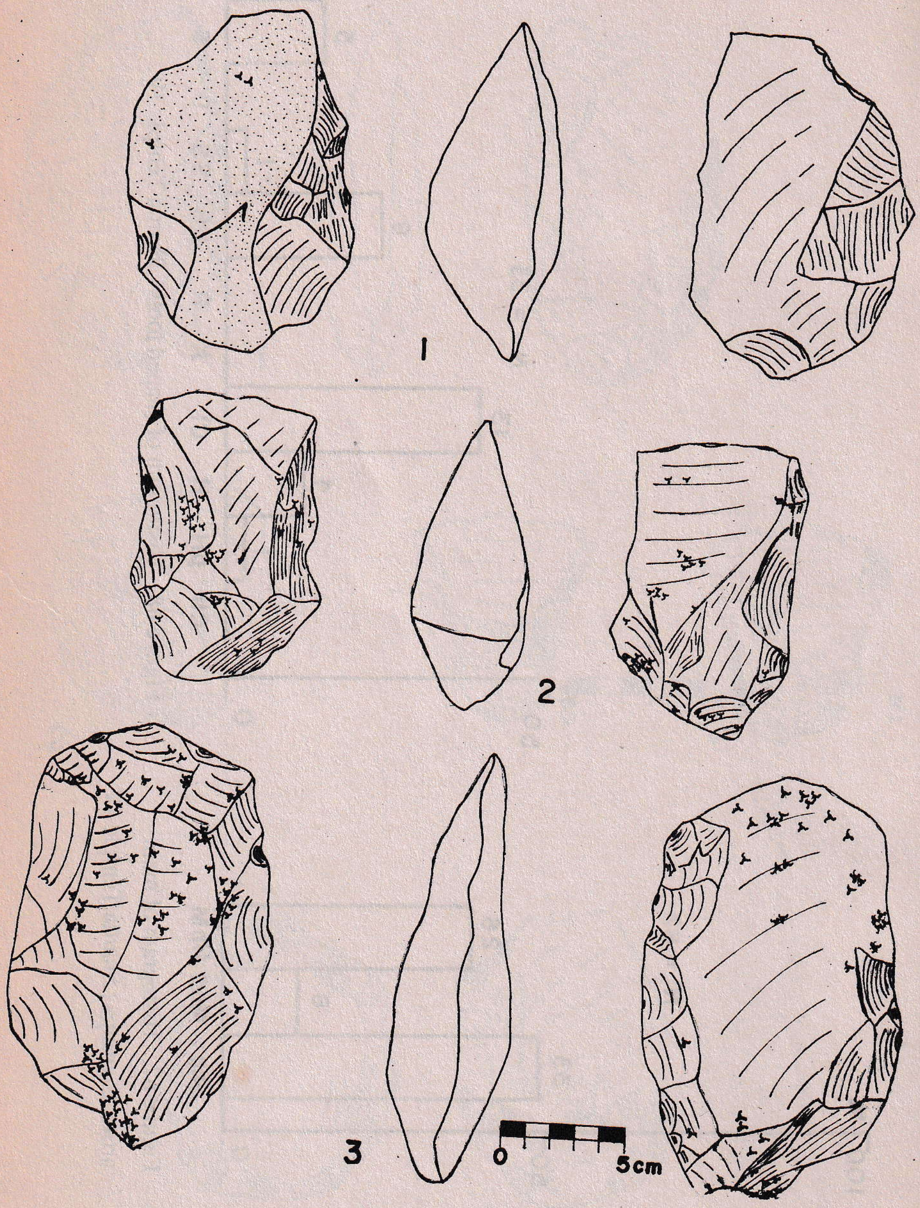

Figure 69. Artifact drawings : Sharda Temple-IV.

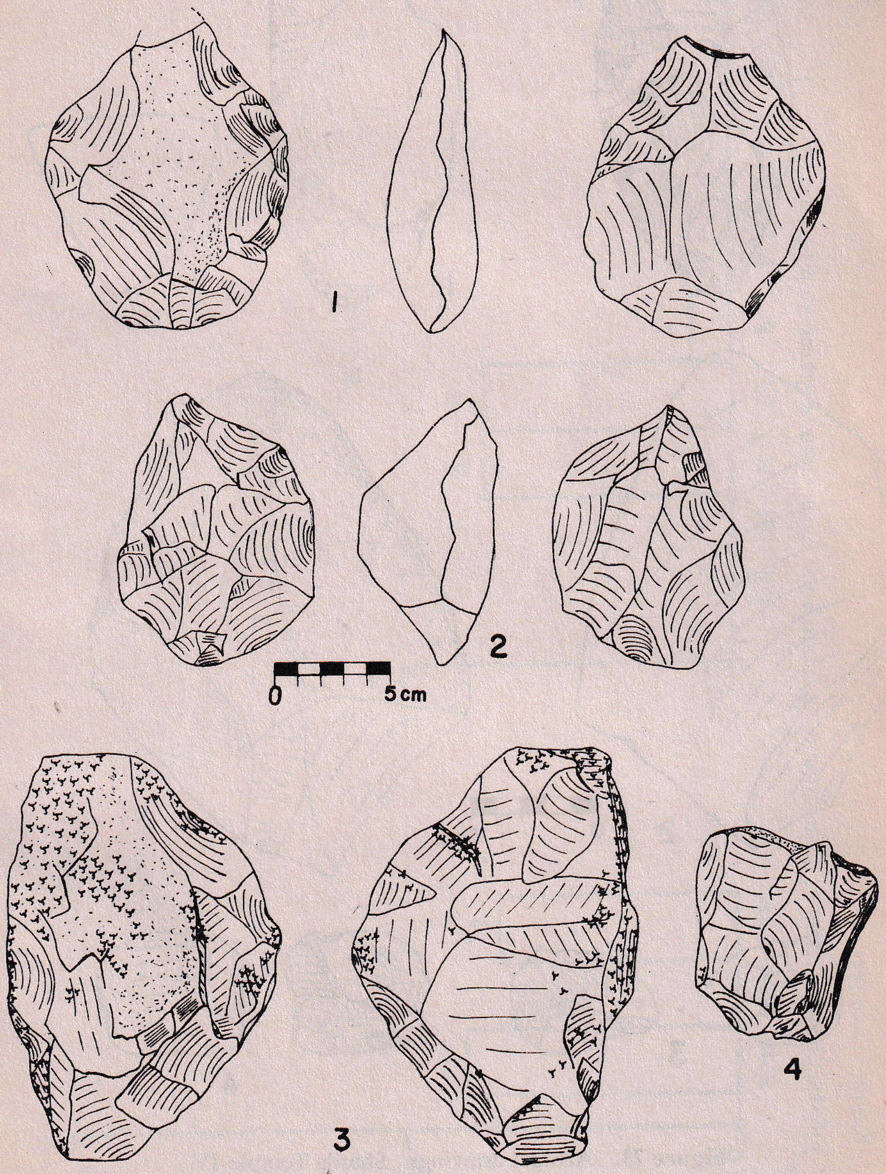

Figure 70. Artifact drawings : Sharda Temple-IV.

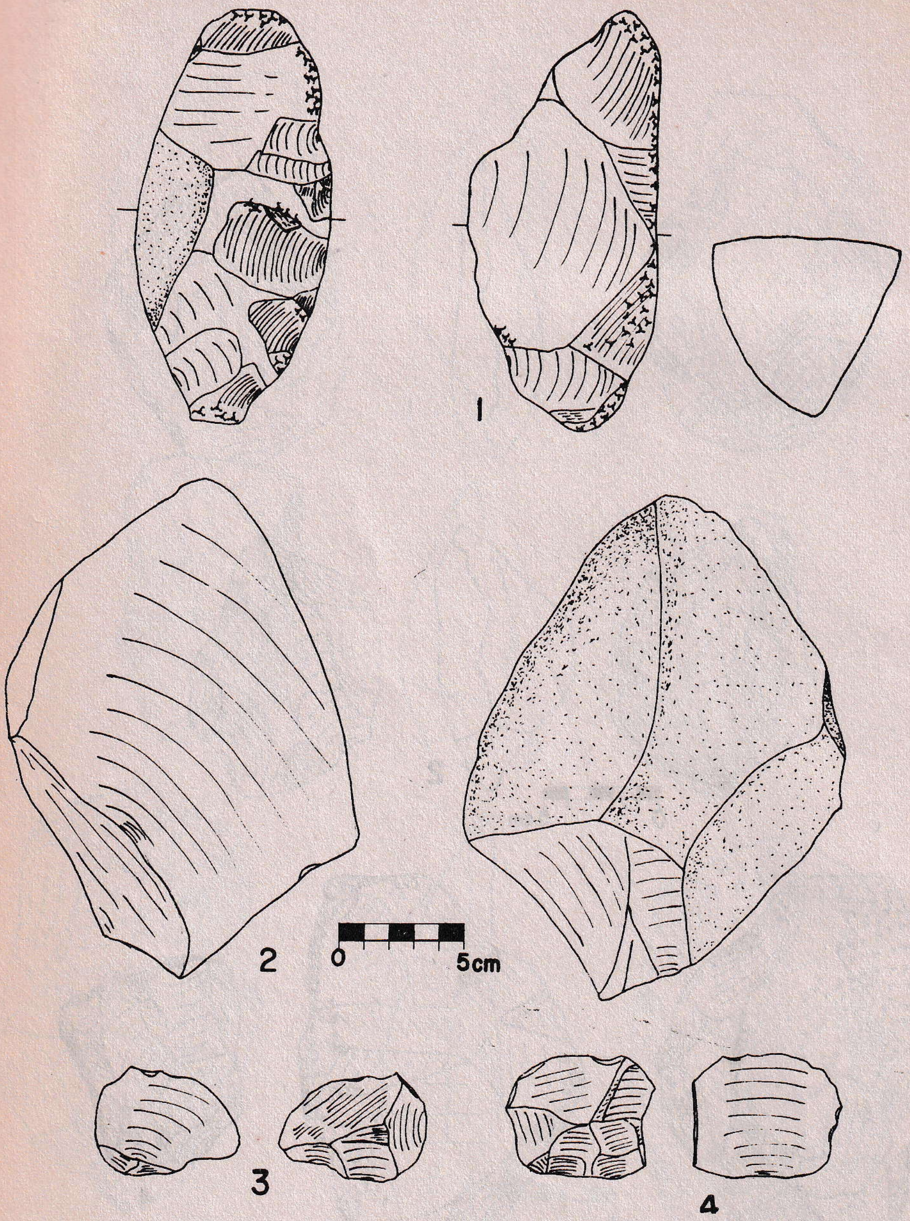

Figure 71. Artifact drawings : Sharda Temple-IV.

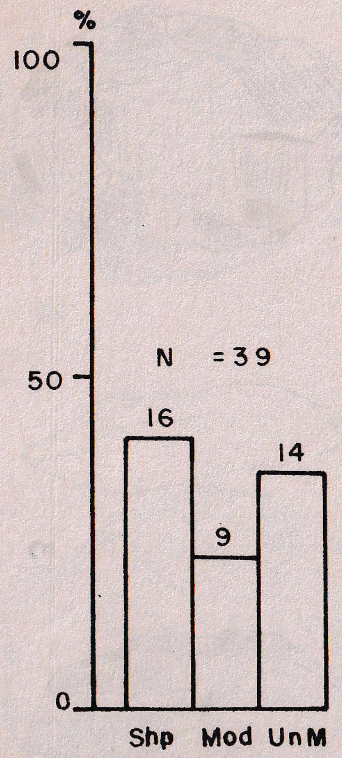

Figure 72. Histogram of main artifacts groups : Naru Hill.

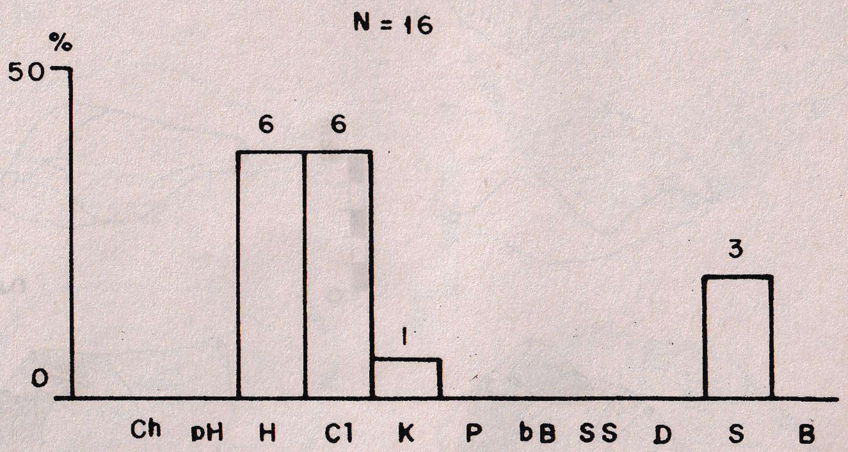

Figure 73. Histogram of shaped tools : Naru Hill.

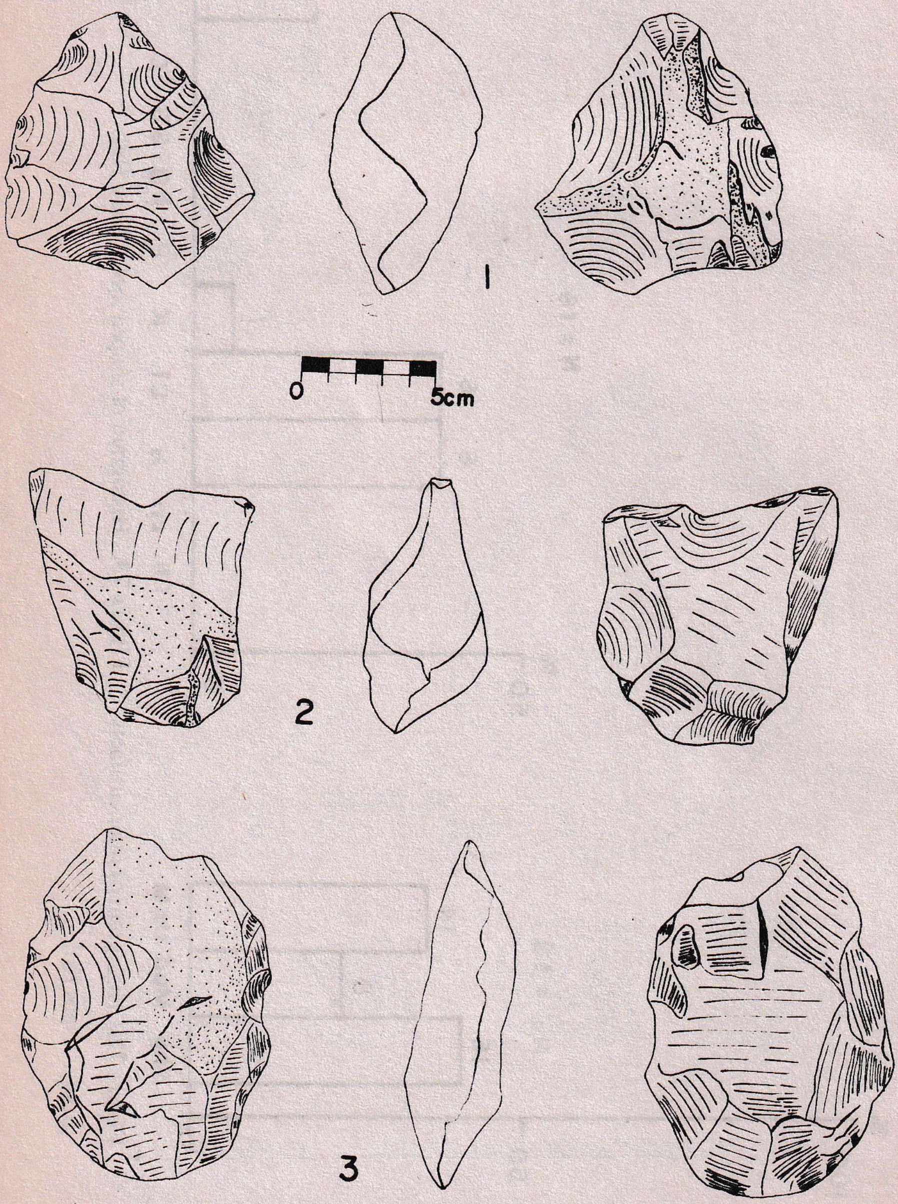

Figure 74. Artifact drawings : Naru Hill.

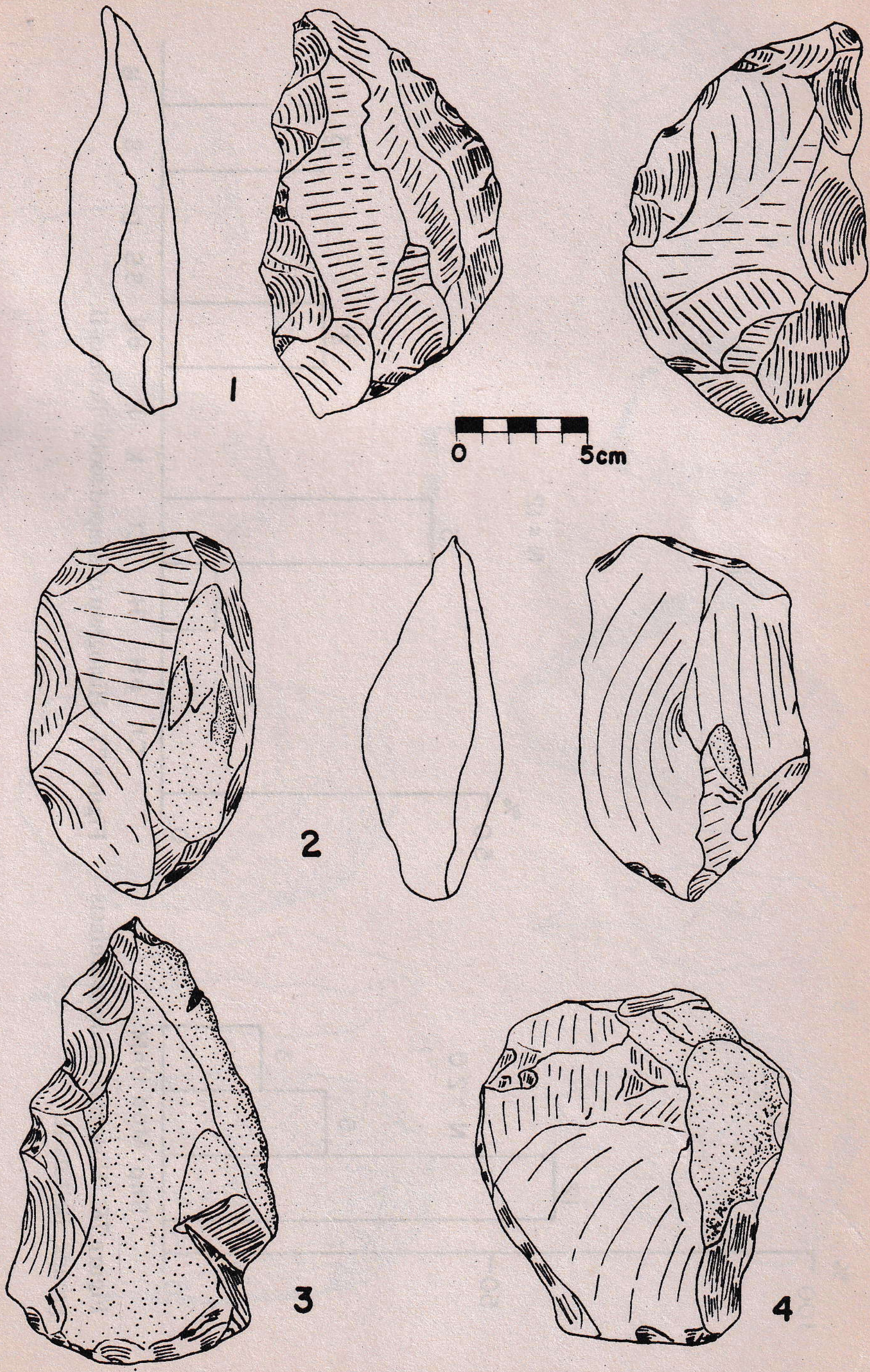

Figure 75. Artifact drawings : Naru Hill.

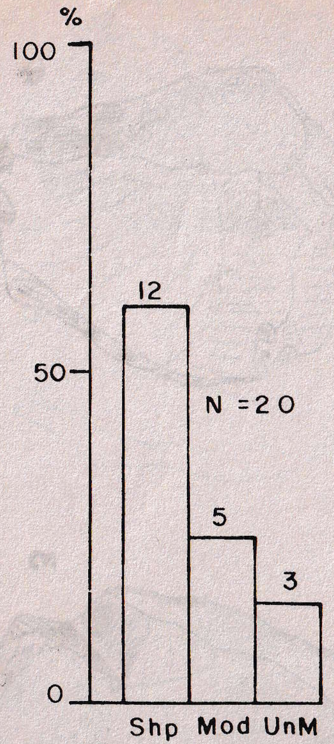

Figure 76. Histogram of main artifacts groups : Belhata-II.

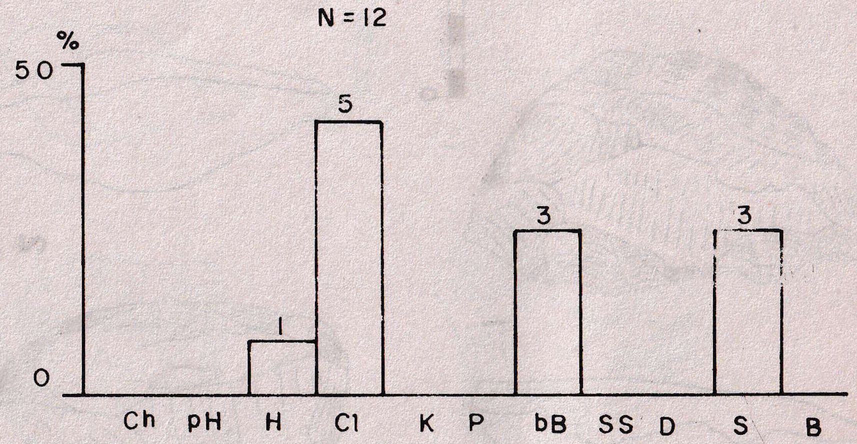

Figure 77. Histogram of shaped tools : Belhata-II.

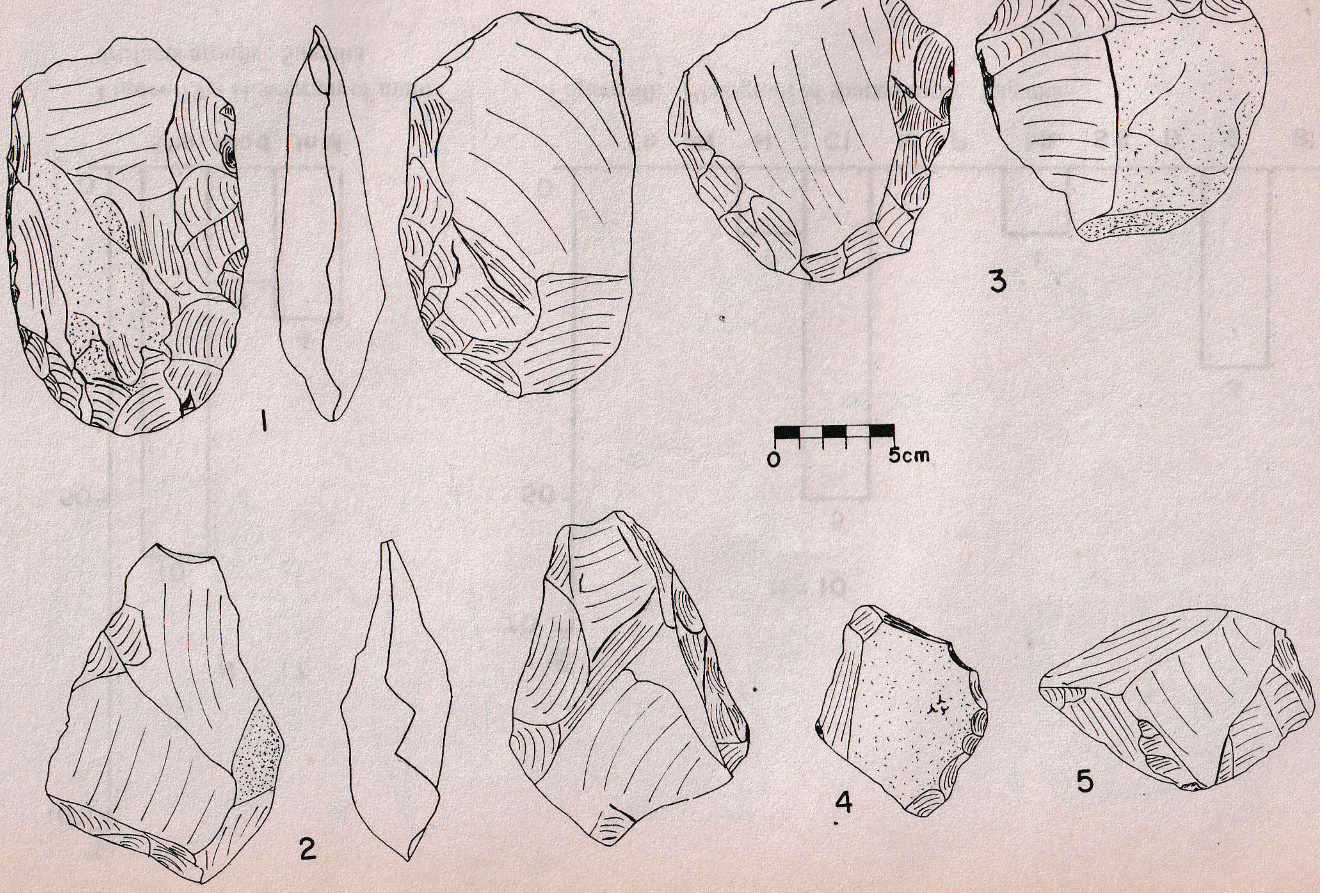

Figure 78. Artifact drawings : Belhata-II.

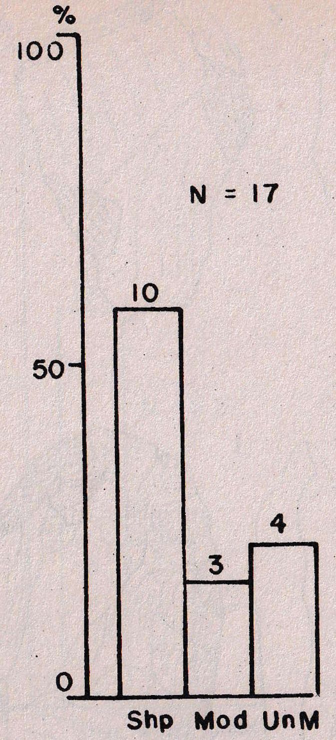

Figure 79. Histogram of main artifacts groups : Sagatha.

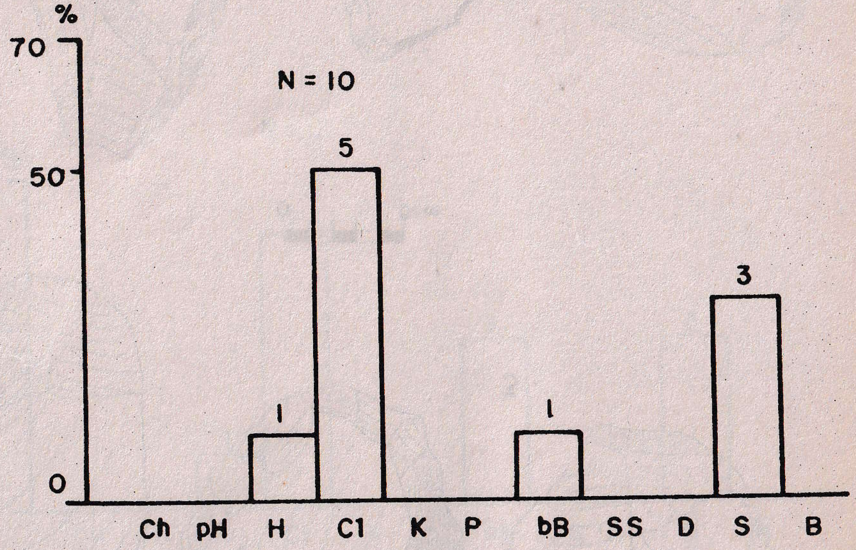

Figure 80. Histogram of shaped tools : Sagatha.

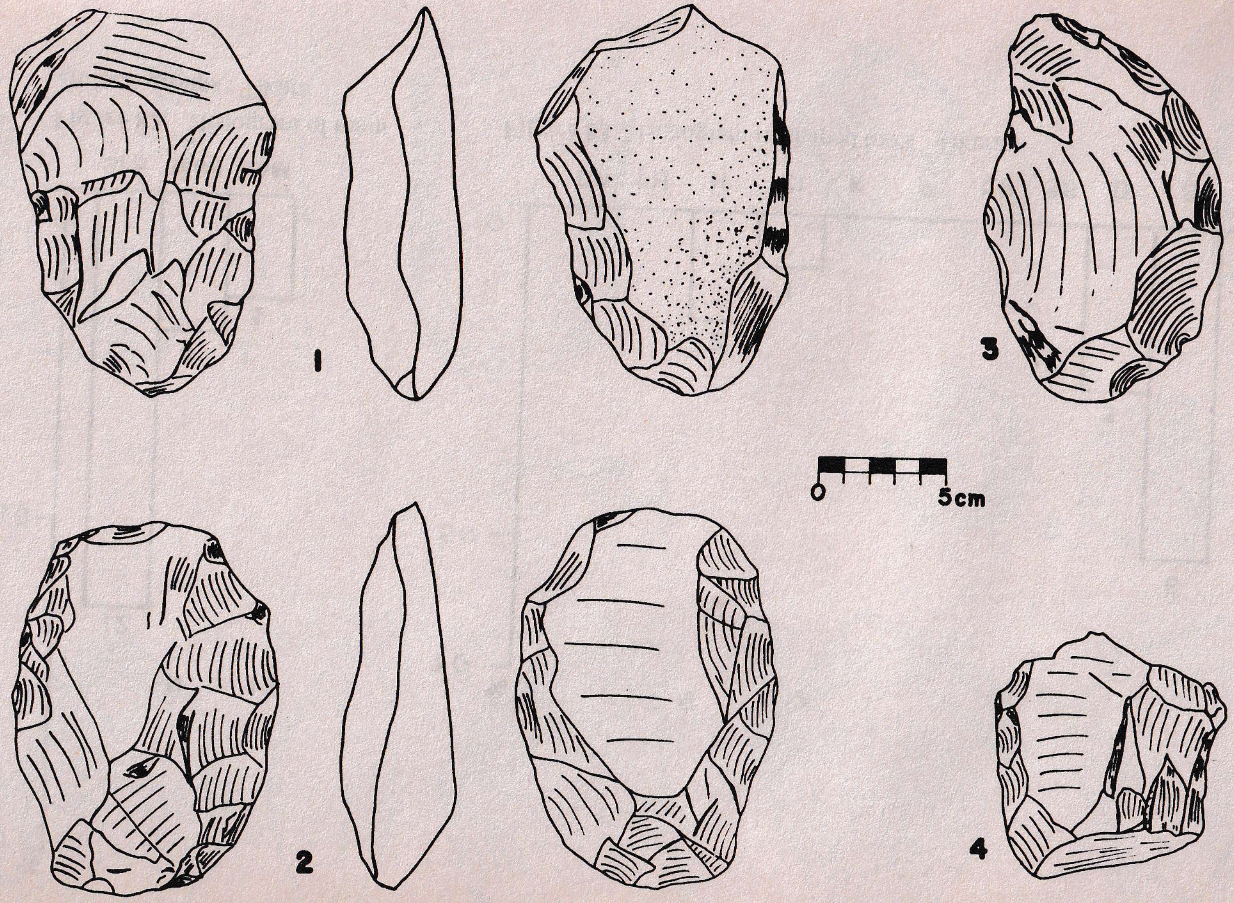

Figure 81. Artifact drawings : Sagatha.

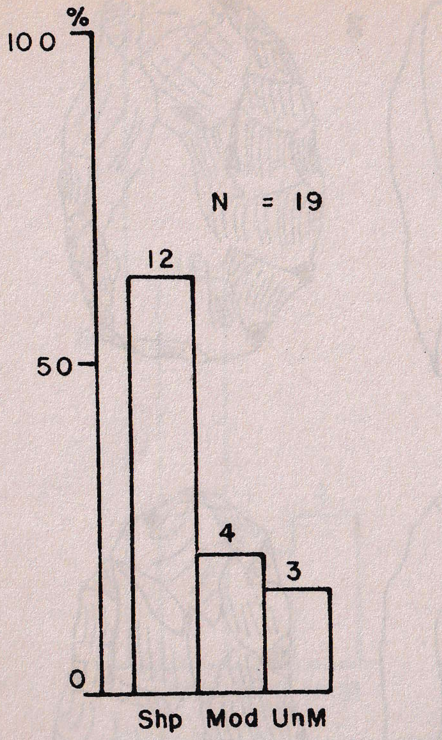

Figure 82. Histogram of main artifacts groups : Tikura

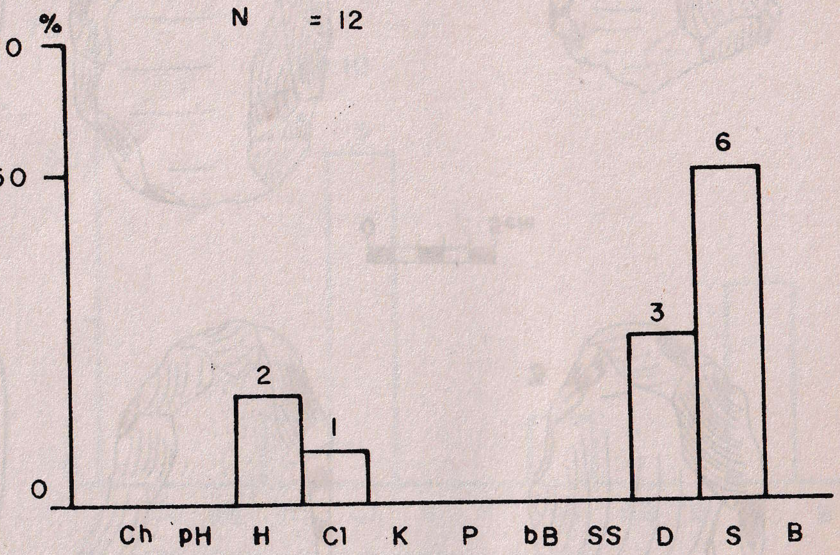

Figure 83. Histogram of shaped tools : Tikura.

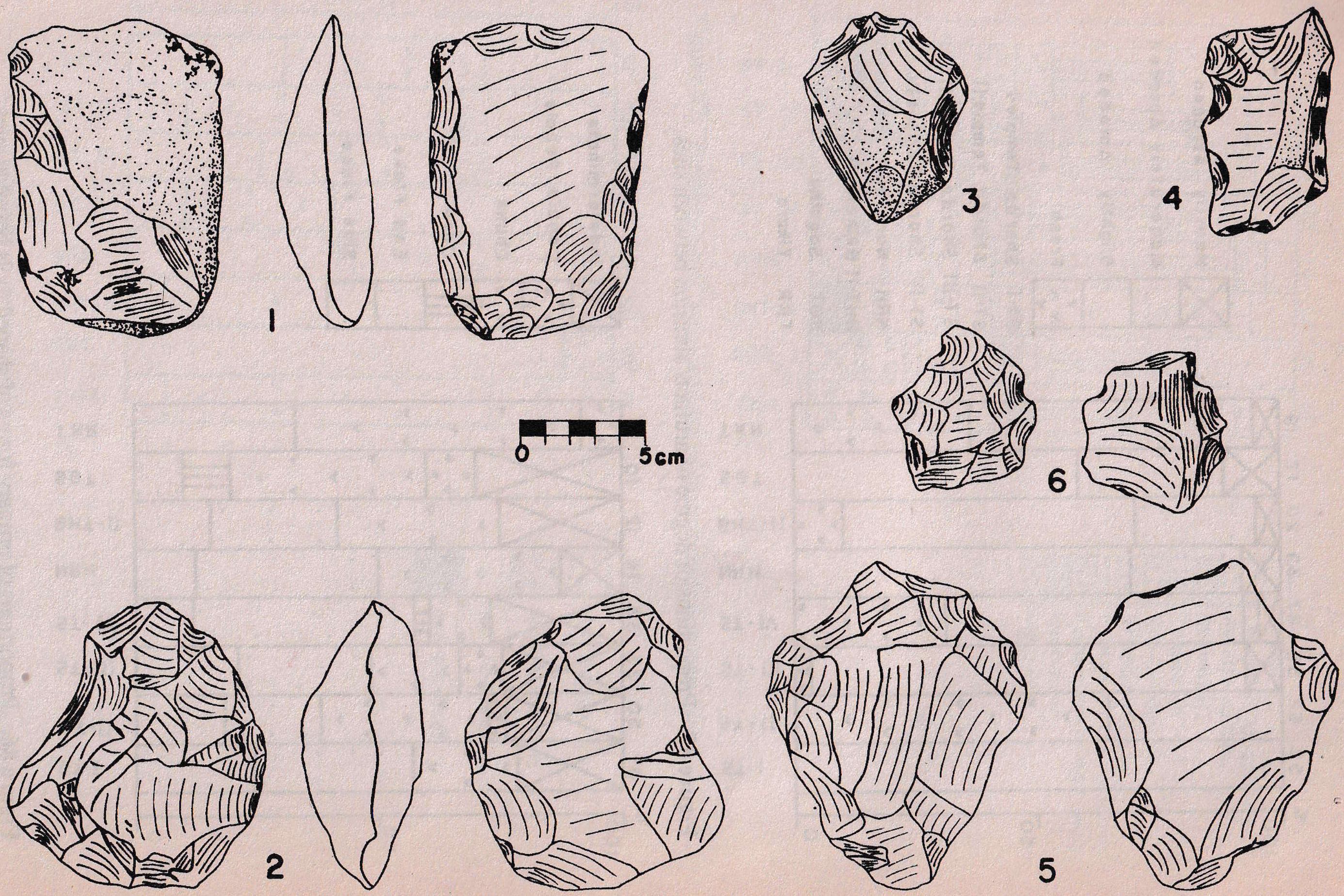

Figure 84. Artifact drawings : Tikura.

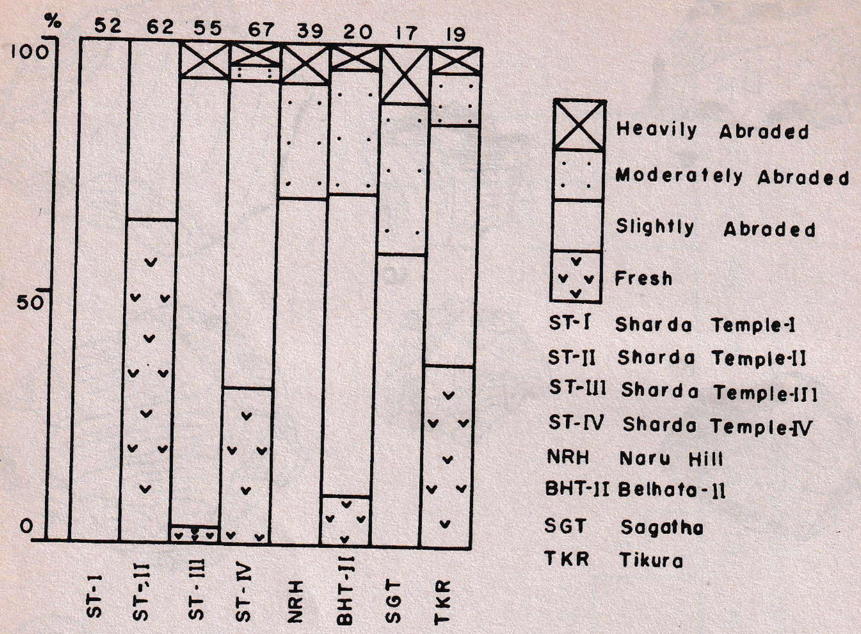

Figure 85. Proportions of degree of artifacts abrasion between sites.

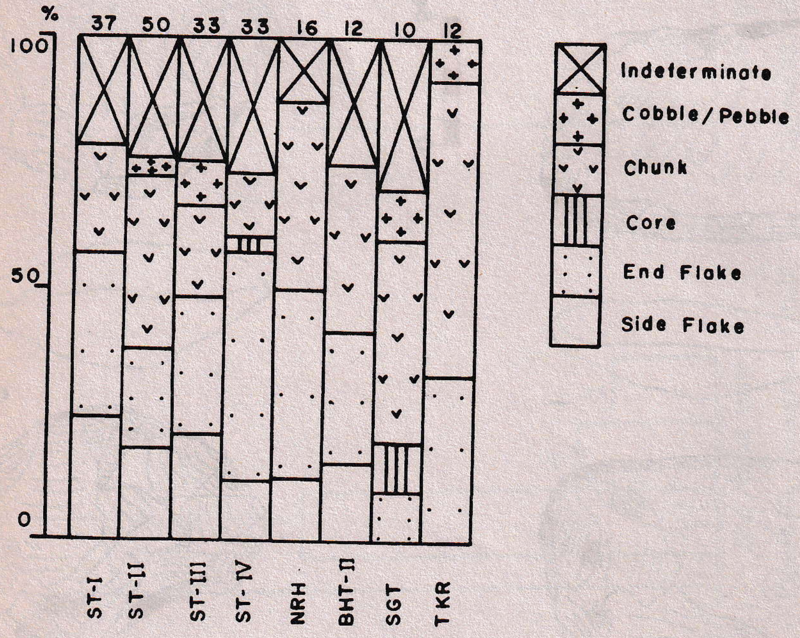

Figure 86. Proportions of primary forms of shaped tools between sites.

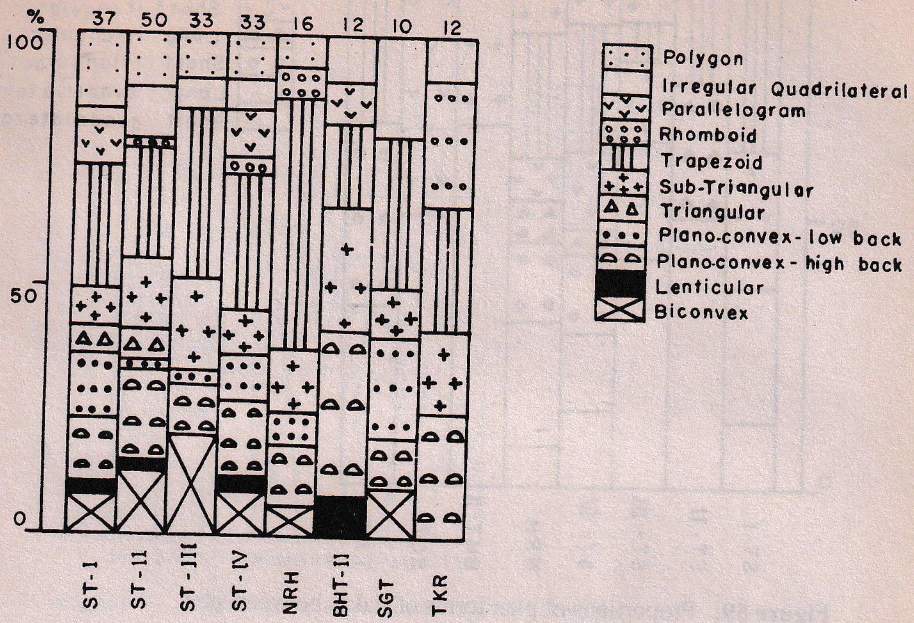

Figure 87. Proportions of cross-sections of shaped tools between sites.

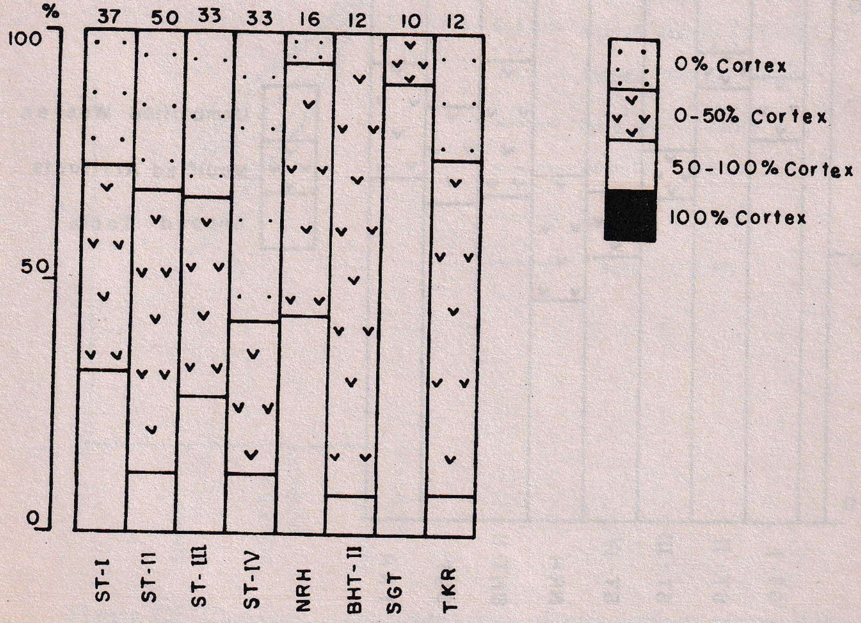

Figure 88. Proportions of presence of cortex on shaped tools between sites.

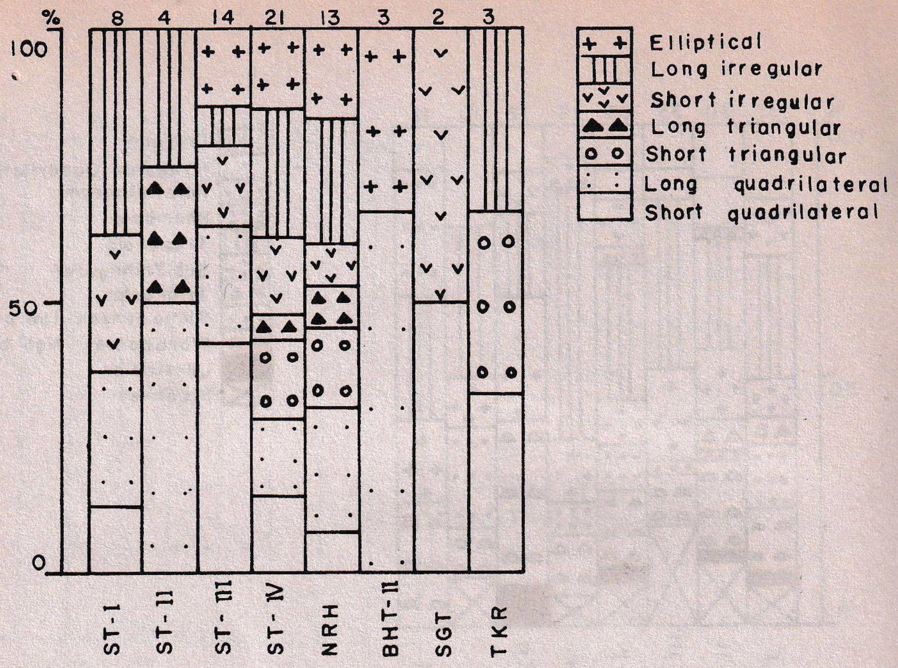

Figure 89. Proportions of plan forms of flakes between sites.

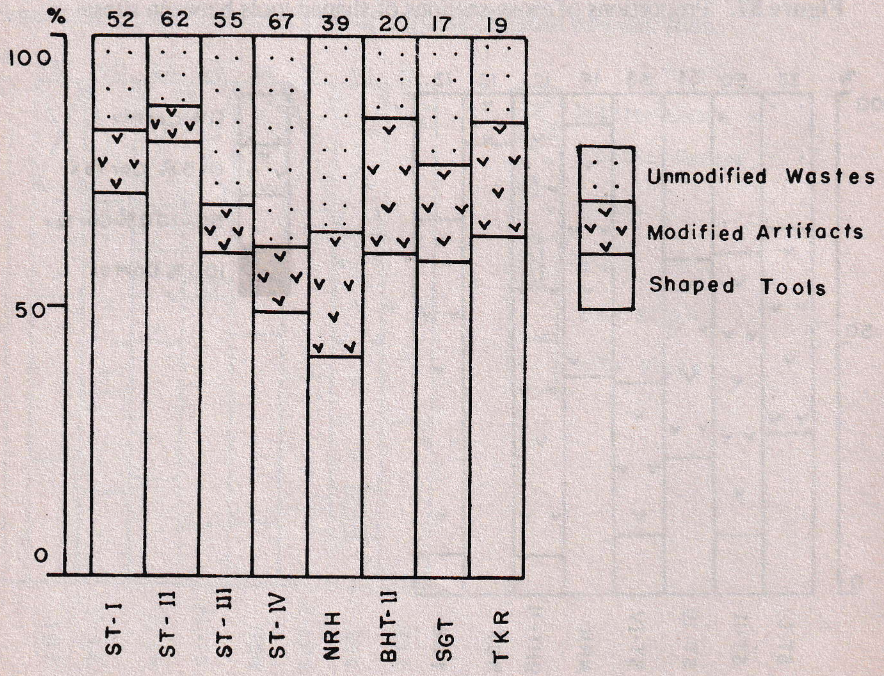

Figure 90. Proportions of main artifacts groups between sites.

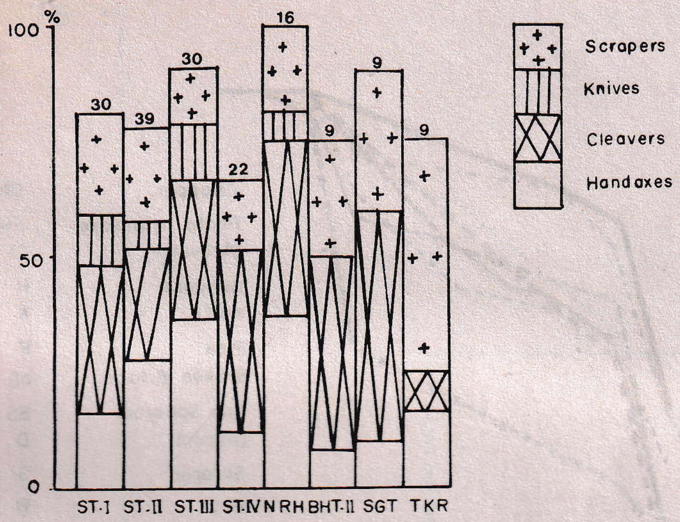

Figure 91. Main tool kits proportions between sites.

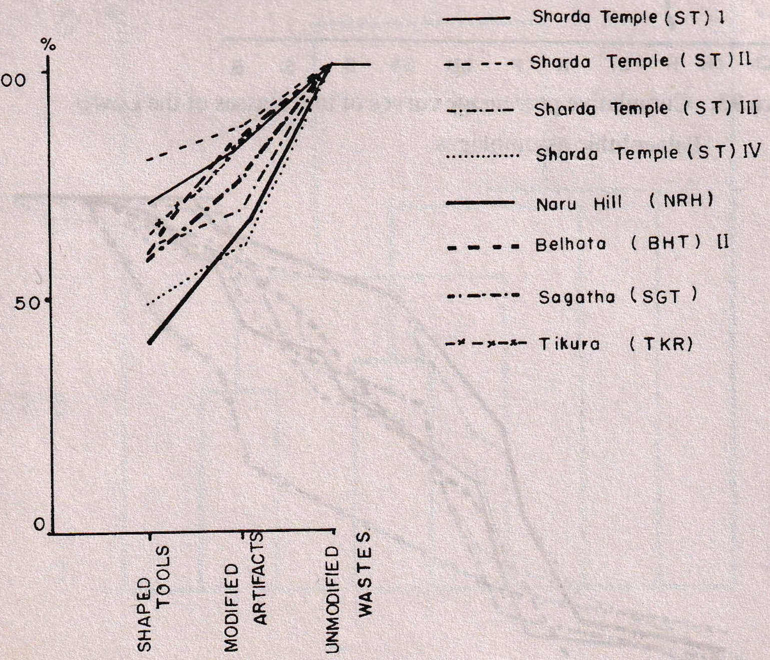

Figure 92. Cumulative percentage curves of main artifacts groups of the Lower Palaeolithic assemblages.

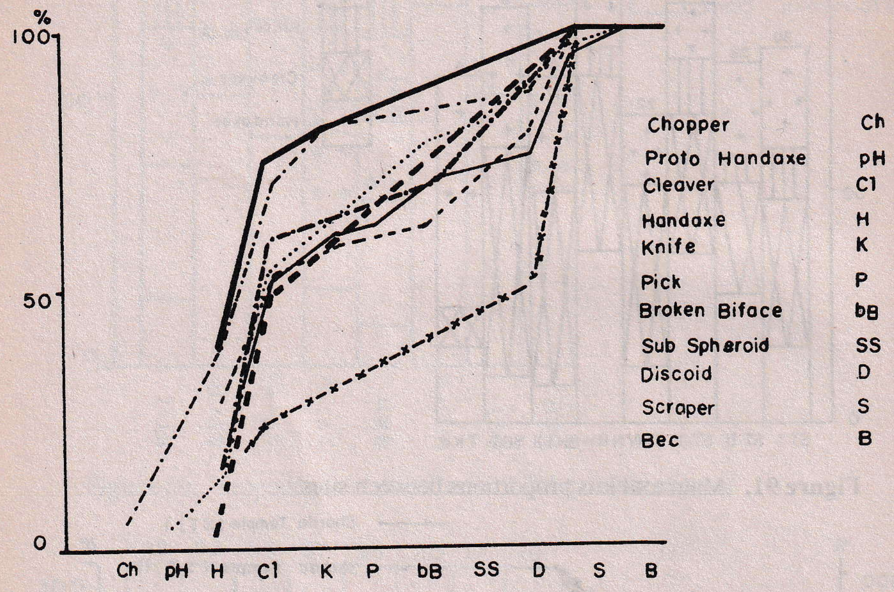

Figure 93. Cumulative percentage curves of tool classes of the Lower Palaeolithic assemblages.

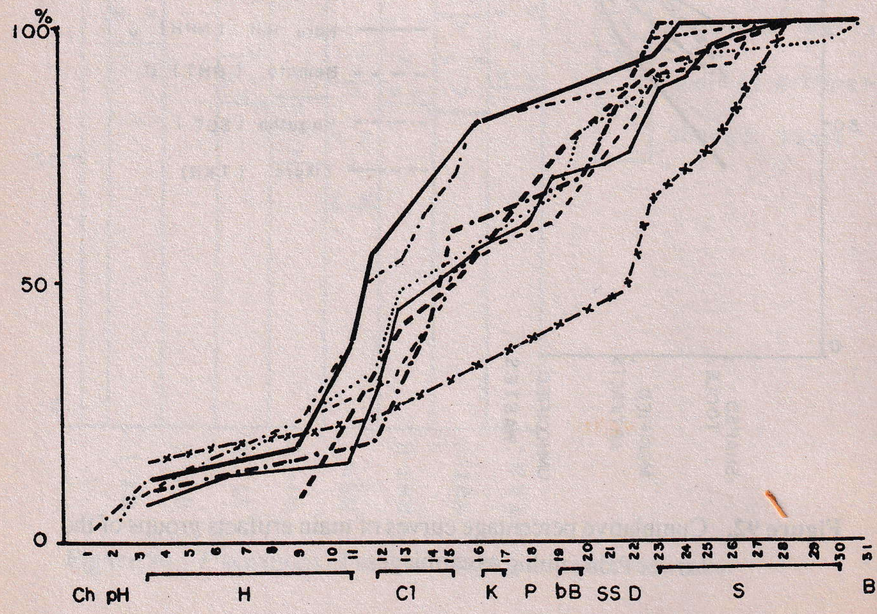

Figure 94. Cumulative percentage curves of tool types of the Lower Palaeolithic assemblages.

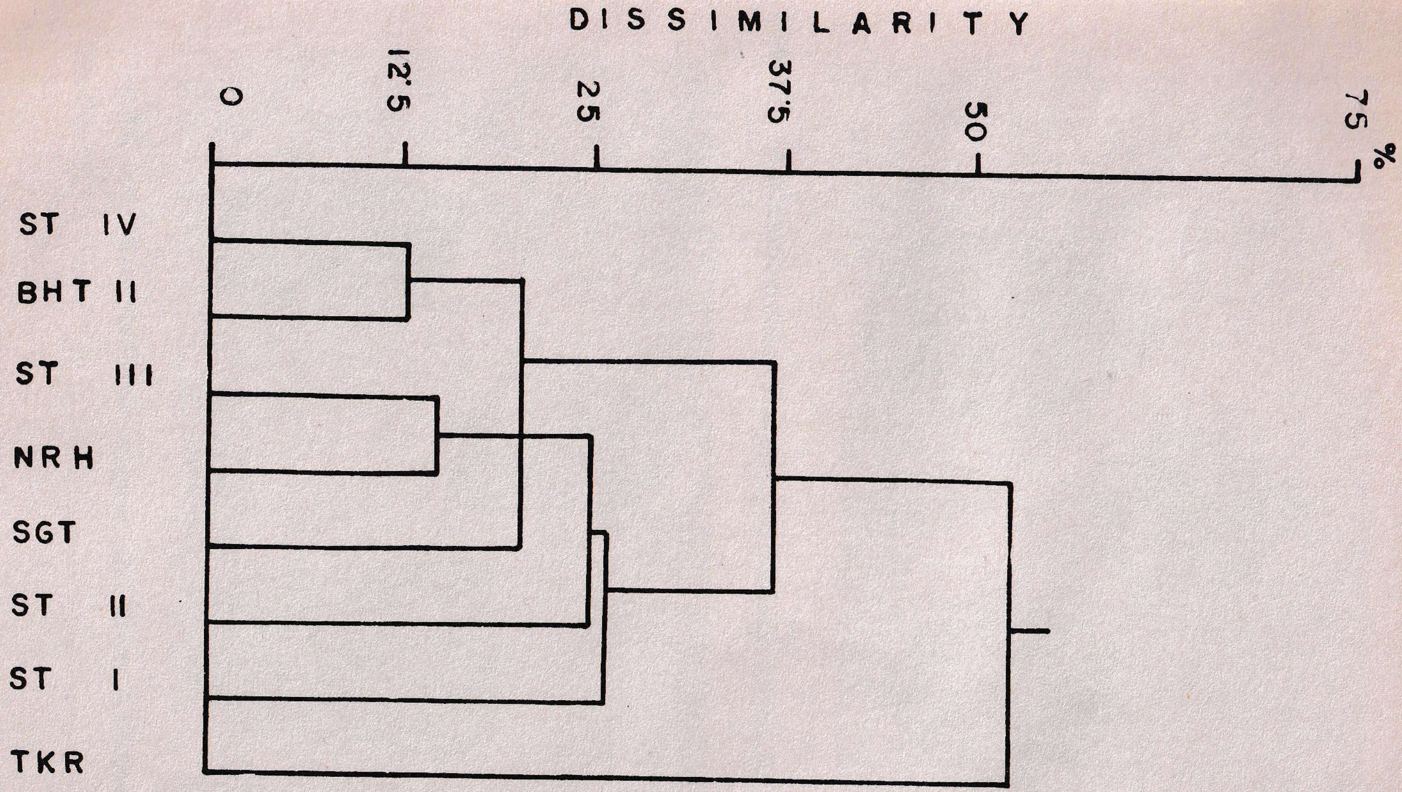

Figure 95. Average-link coefficient dendogram grouping of complete tool kits of the Lower Palaeolithic sites.

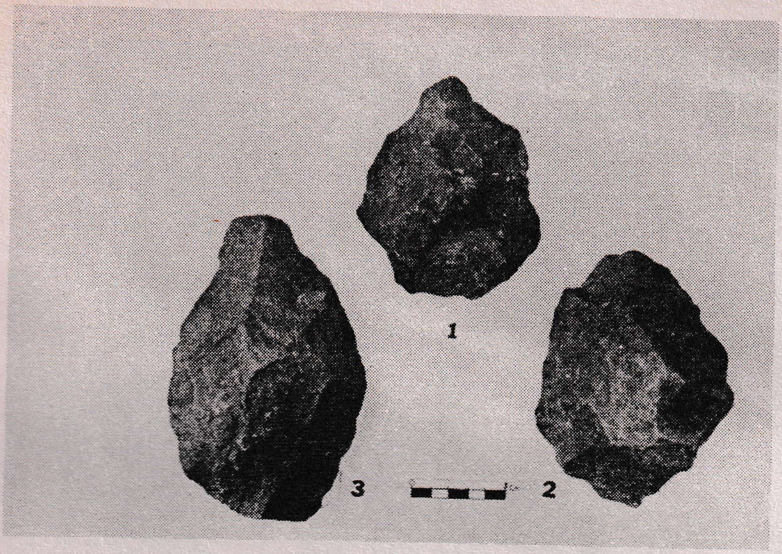

Plate X. Artifacts from Sharda Temple-I. 1-2, Handaxes; 3, Pick (See Fig. 54).

Plate XI. Artifacts from Sharda Temple-I. 1-2, Cleavers; 3, Handaxe (See Fig. 55).

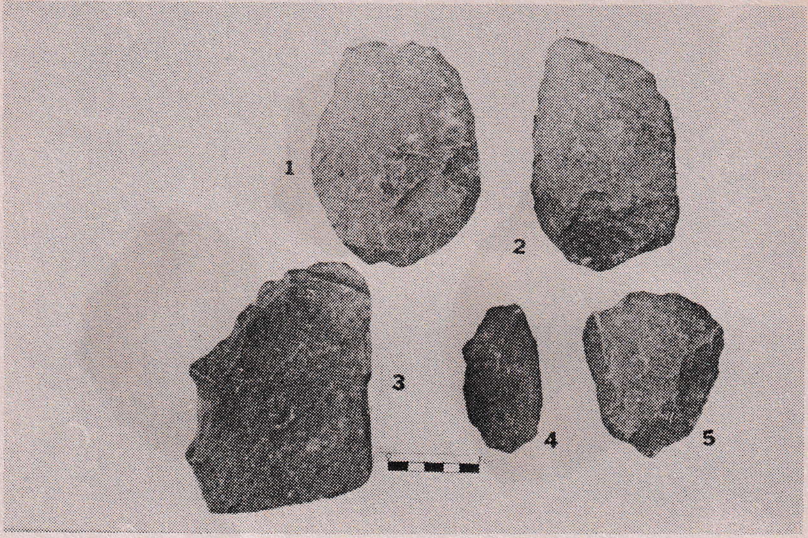

Plate XII. Artifacts from Sharda Temple-I. 1-2, Knives; 3-4, Scrapers (See Fig. 56).

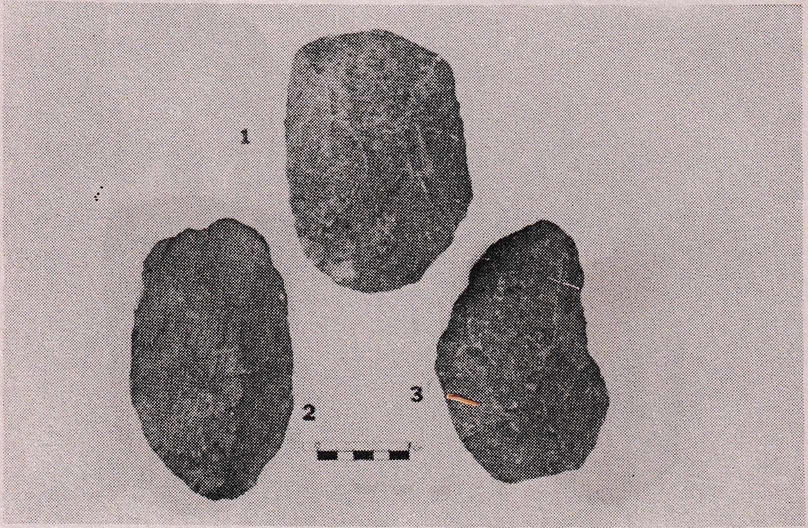

Plate XIII. Artifacts from Sharda Temple-II. 1-2, Cleavers; 3, Handaxe (See Fig. 59).

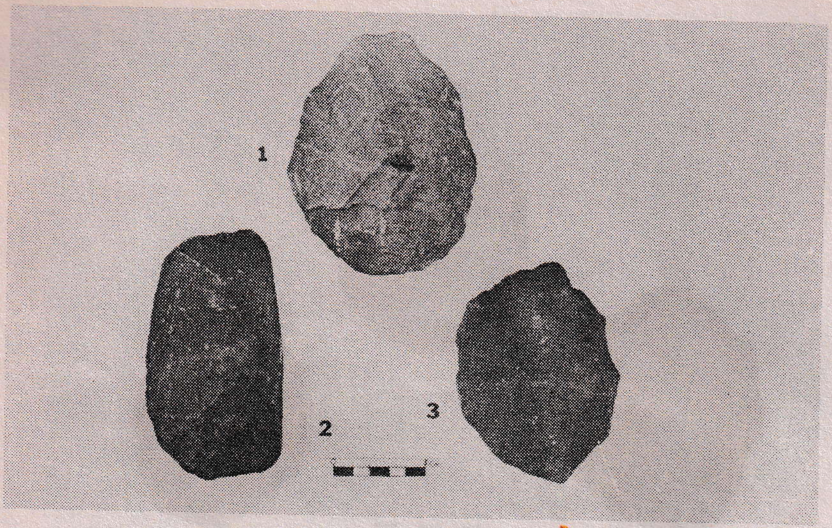

Plate XIV. Artifacts from Sharda Temple-II. 1-3, Handaxes; 2, Knife (See Fig. 60).

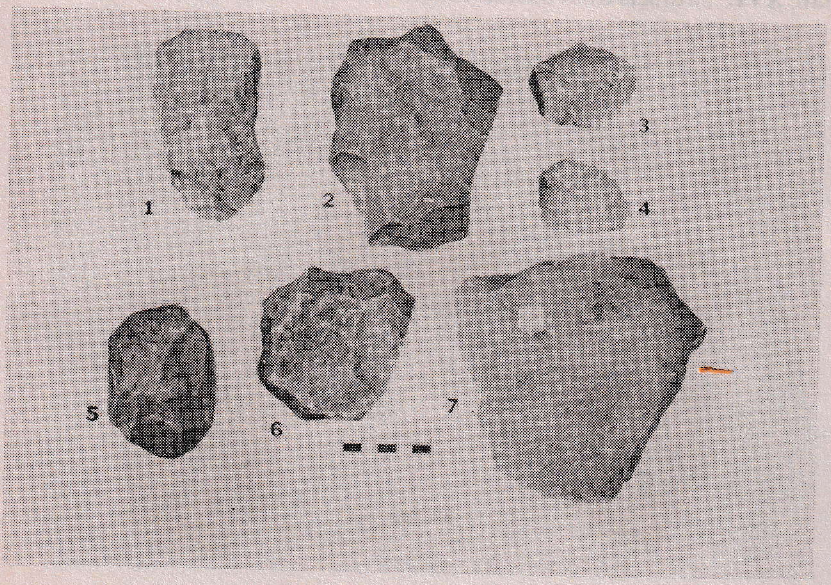

Plate XV. Artifacts from Sharda Temple-II. 1, Cleaver; 2, 6, Scrapers; 3-4, Biface trimming flakes; 5, Discoid; 7, Flake (See Fig. 61).

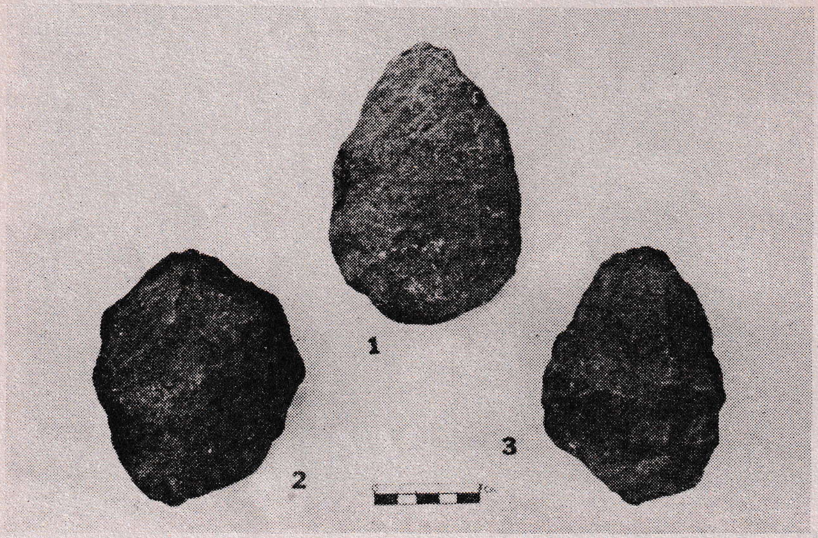

Plate XVI. Artifacts from Sharda Temple-III. 1-3, Handaxes (See Fig. 64).

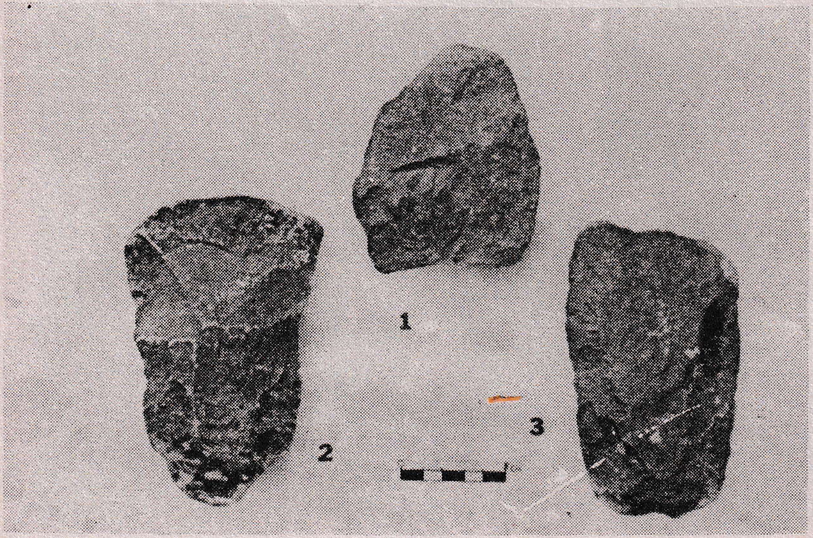

Plate XVII. Artifacts from *Sharda* Temple-III. 1, Handaxe; 2-3, Cleavers (See Fig. 65).

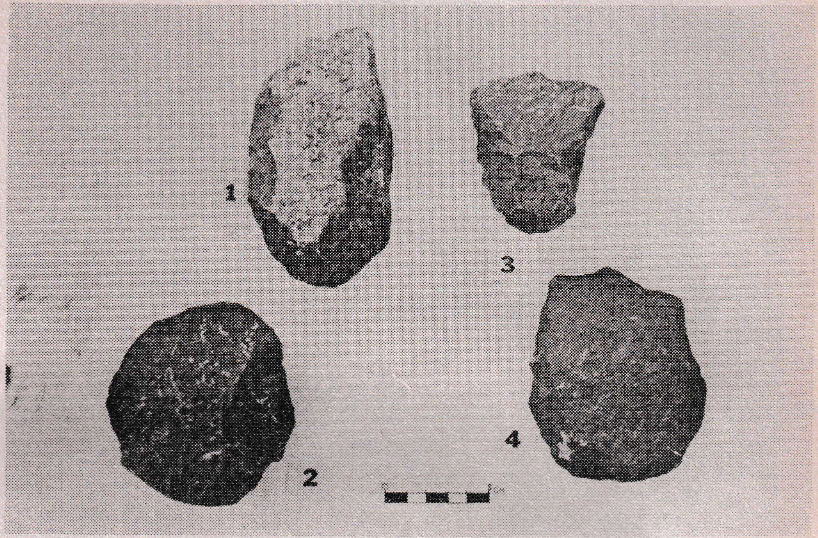

Plate XVIII. Artifacts from Sharda Temple-III. 1, Knife; 2, Discoid; 3, Cleaver; 4, Scraper (See Fig. 66).

Plate XIX. Artifacts from Sharda Temple-IV. 1-3, Cleavers (See Fig. 69).

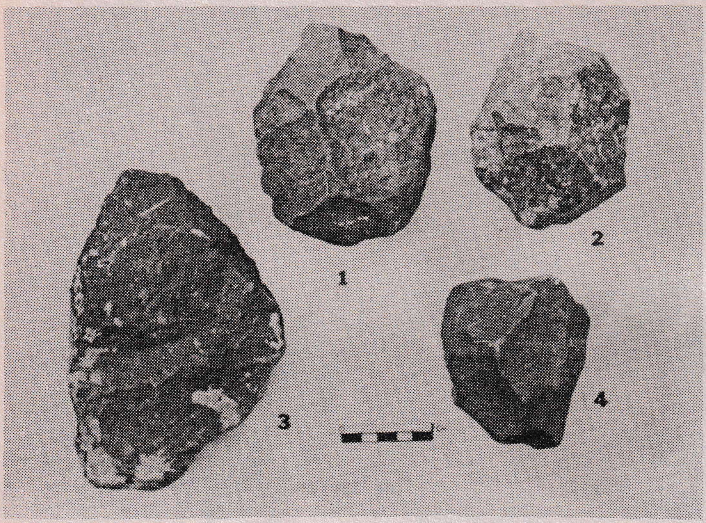

Plate XX. Artifacts from Sharda Temple-IV. 1-2, Handaxes; 3, Bec; 4, Sub-spheroid (See Fig. 70).

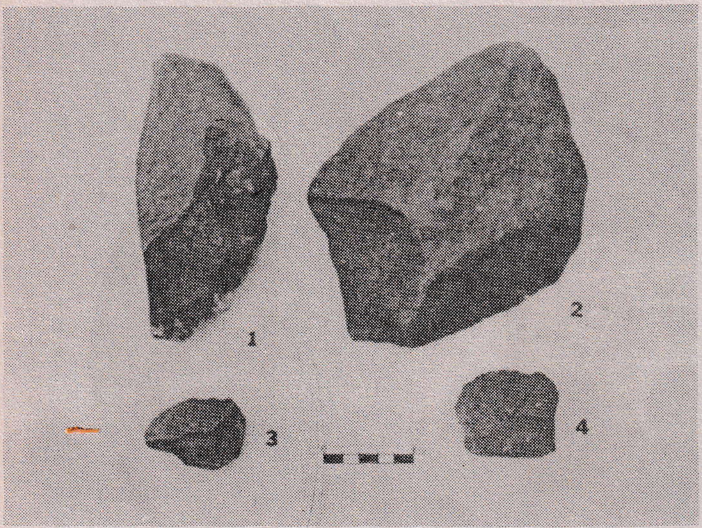

Plate XXI. Artifacts from Sharda Temple-IV. 1, Scraper; 2, Flake; 3-4, Biface trimming flakes (See Fig. 71).

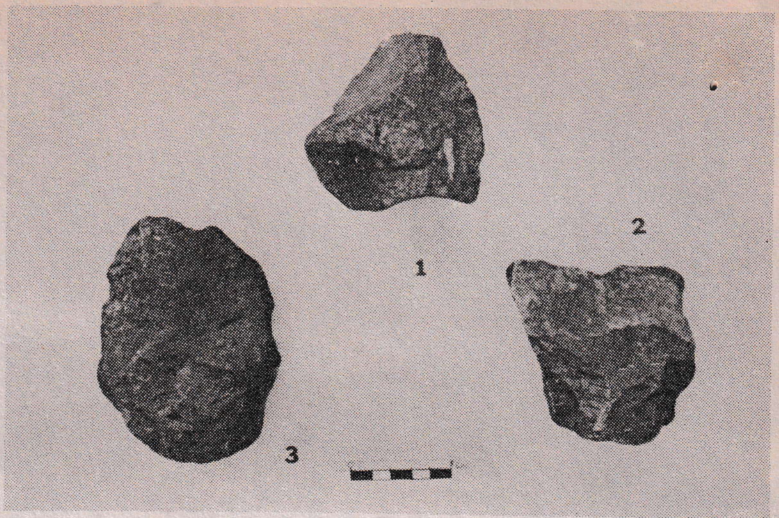

Plate XXII. Artifacts from Naru Hill. 1, Handaxe; 2, Cleaver; 3, Knife (See Fig. 74).

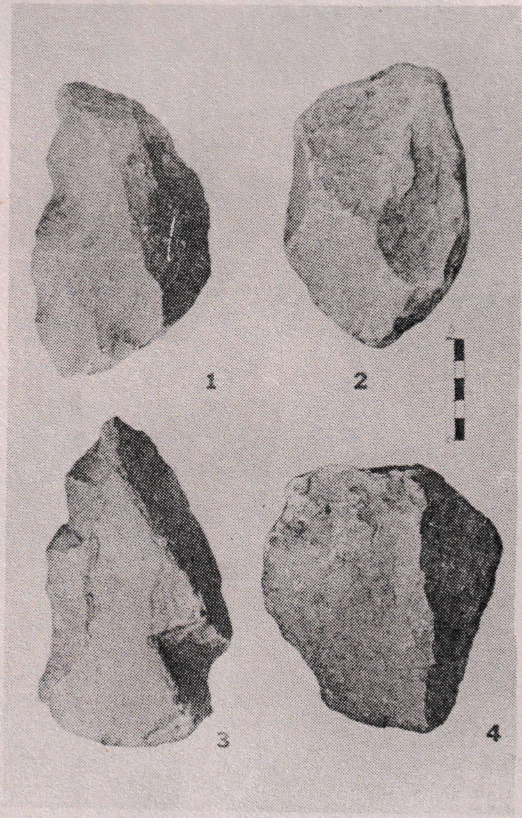

Plate XXIII. Artifacts from Naru Hill. 1, Handaxe; 2, Cleaver; 3, Scraper; 4, Flake (See Fig. 75).

Plate XXIV. Core, *in situ* at Naru Hill.

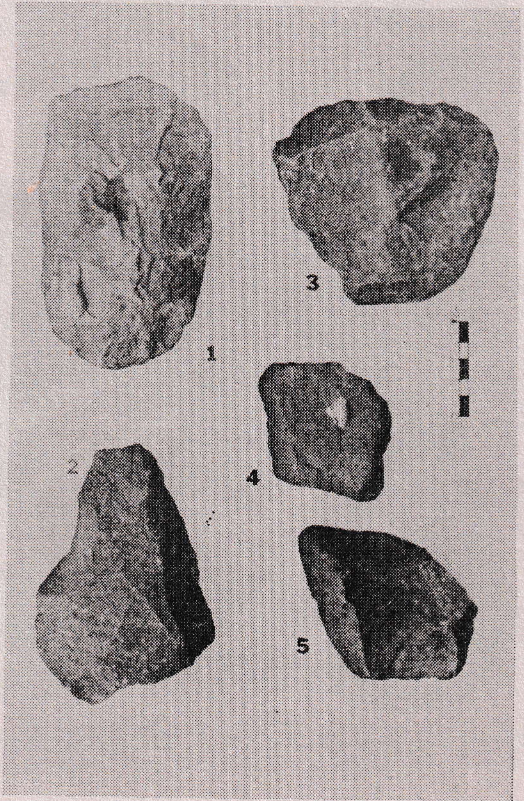

Plate XXV. Artifacts from Belhata-II. 1, Cleaver; 2, Handaxe; 3-4, Scrapers; 5, Flake (See Fig. 78).

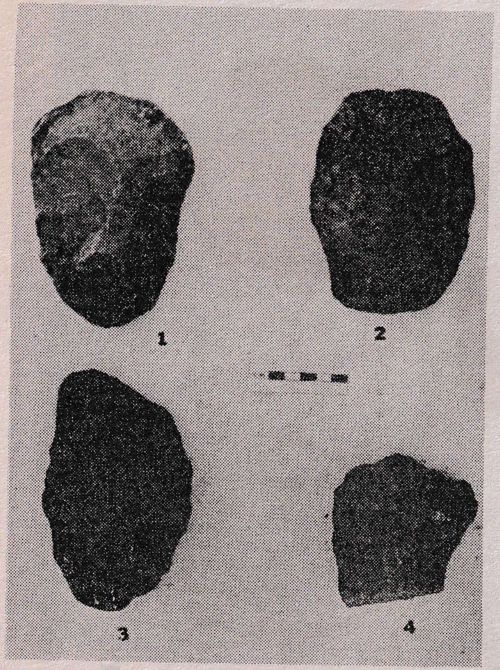

Plate XXVI. Artifacts from Sagatha. 1, Cleaver; 2, Handaxe; 3-4, Scrapers (See Fig. 81).

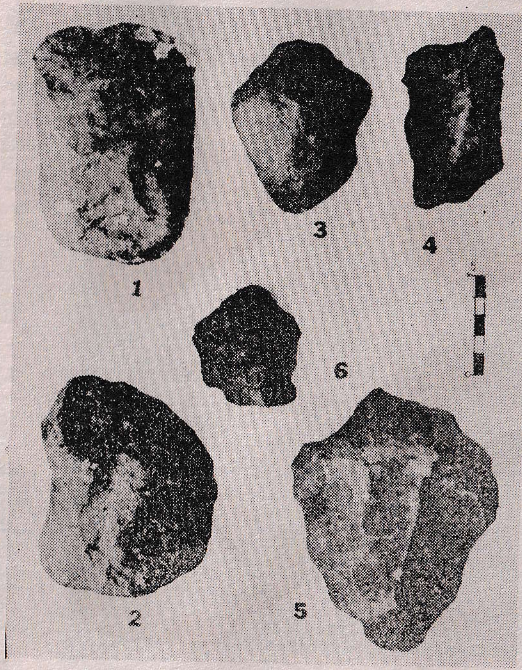

Plate XXVII. Artifacts from Tikura. 1, Cleaver; 2, Handaxe; 3-5, Scrapers; 6, Discoid (See Fig. 84).

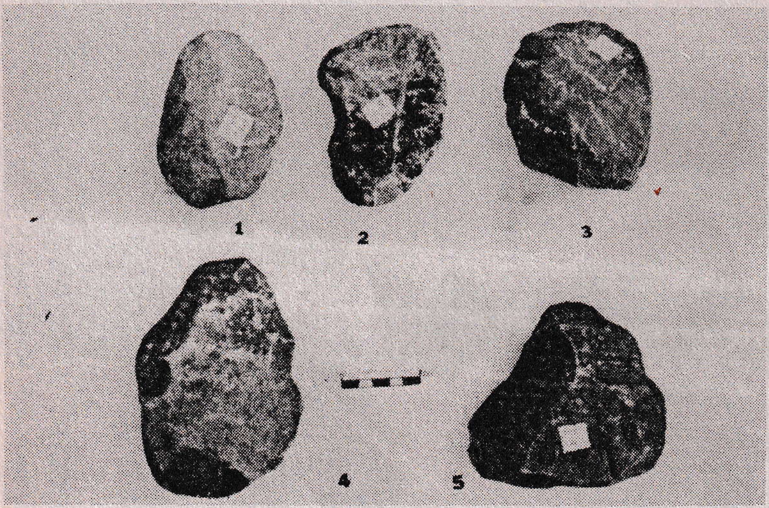

Plate XXVIII. Artifacts from Rampur-II. 1, Handaxe; 2, Cleaver; 3, Knife; 4, Scraper; 5, Flake.

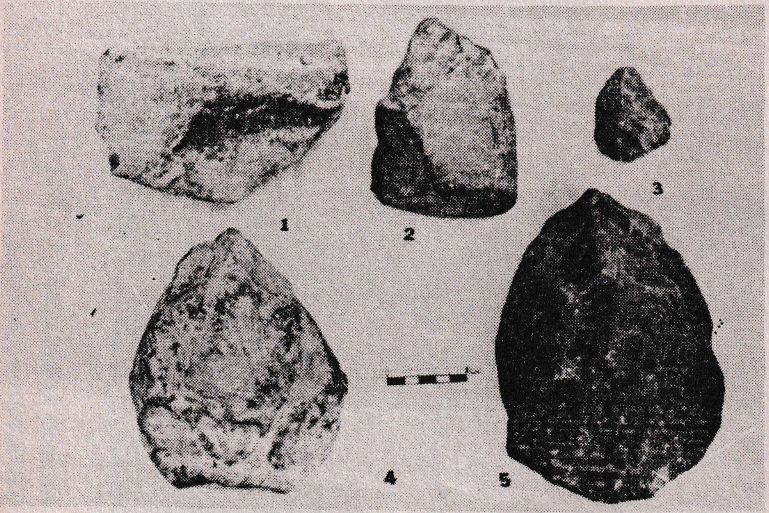

Plate XXIX. Artifacts from Arahnia Ghat. 1, 5, Flakes; 2, Chopper; 3, Scraper; 4, Handaxe.

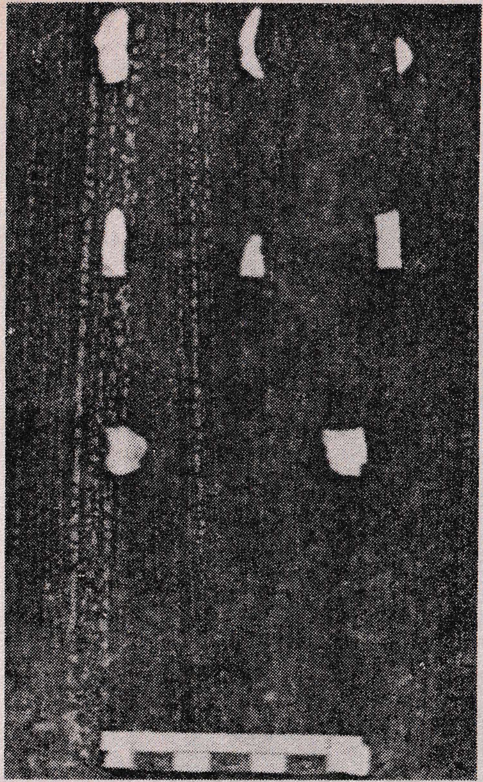

Plate XXX. Artifacts from Satari section. Microliths.

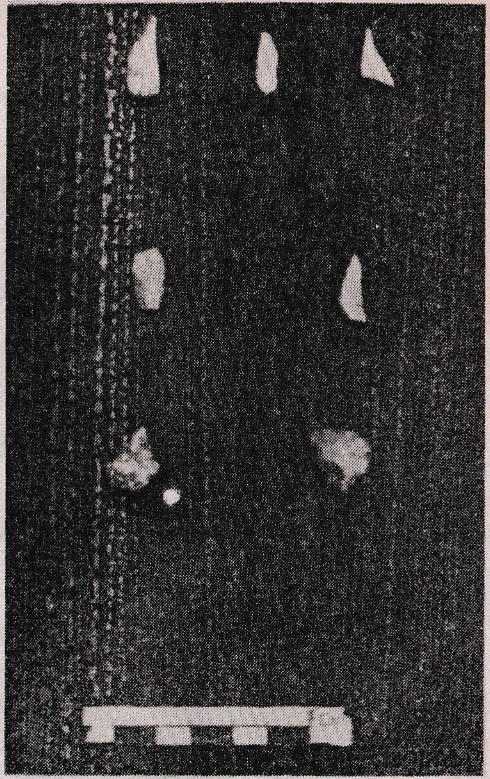

Plate XXXI. Artifacts from Rampur section. Microliths.

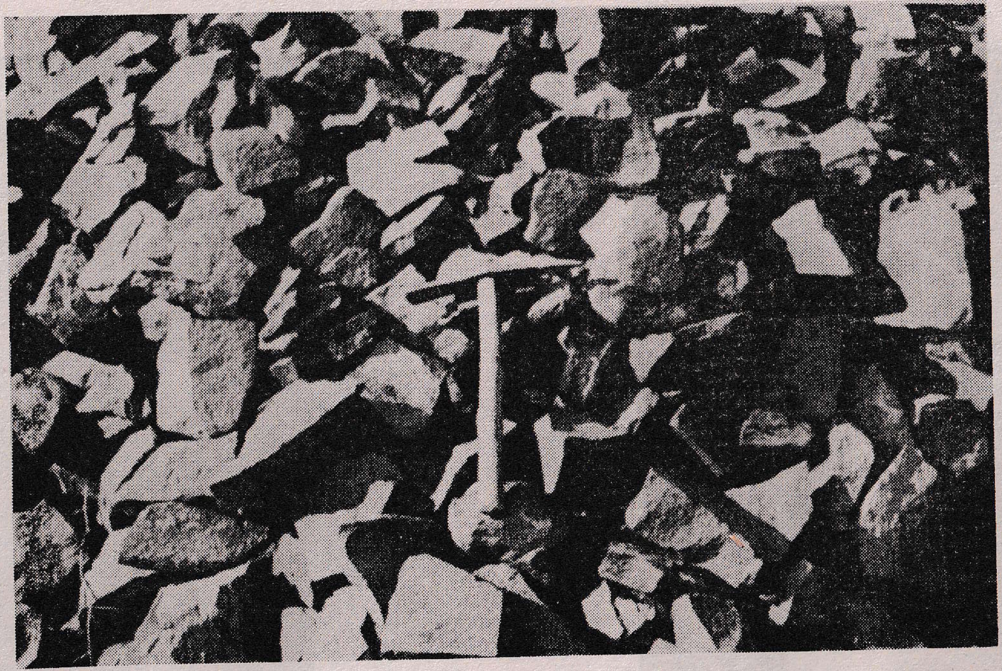

Plate XXXII. Quarry work close to Rampur-II : point of peg points broken cleaver.

7 Discussion

The concluding chapter deals with discussion and observations on some of the major problems raised and investigated in the present work. It involves discussion on the comparison of the artifacts and sites of our study area with those of other regions ; the chronology of the Upper Tons valley ; the subsistence activities at the sites ; the limitations of morphological functional analysis ; the settlement pattern ; the evaluation of the methodology used in the work and the last section presents the conclusions.

Comparison

Comparative analysis of the artifacts has been usually based upon the characteristic features of flint-knapping technique, typology and stratigraphy. In the absence of the latter i.e. stratigraphical evidences, obviously, it is generally done in relation to the former two factors i.e. flint-knapping technique and typology. Although, raw material forms one of the important elements of flint-knapping technique, but curiously enough it is hardly considered in the 'between sites analysis' of flint-knapping technique. The said element not only causes difference in the selection of fabricator and technique but sometimes also in the tool types. Furthermore, it is found that sometimes analyst refer to 'crude heavy biface' or 'fine heavy biface', perhaps, without taking into account the above mentioned element and they interpret industries as early or late. These points should be born in mind, besides other important factors, while attempting to comparative artifacts analysis between sites. These observations are based mainly on the experiments with flint-knapping conducted by the present researcher (Sinha, 1984, Appendix-B), or such observations have also been made by other scholars e.g. Crabtree (1967a, 1967b, 1972),Newcomer (1971, 1975).

The stone artifacts of the Lower Palaeolithic assemblages sampled at different sites in the study area are fashioned on quartzite, though boulders/cobbles of coarse sandstone and quartz are also available, besides quartzite in the study area. This probably shows that even in this period prehistoric man had experienced the importance of the grain sizes of different types of raw materials. Typologically and technologically the artifacts of almost all the Lower Palaeolithic sites belong to similar tradition. Further, if the predominance of ovate and sub-triangular handaxes and quadrilateral cleavers is of any significance in characterisation of the Lower Palaeolithic assemblages

as has been suggested and reported by scholars in African context, then the Lower Palaeolithic sites of Satna district, explored and analysed so far, may be placed under the Upper (late) Acheulian tradition, rather than Lower/ Middle Acheulian. As far as Indian context is concerned, these sites have closer resemblance with the later, rather than the earlier Acheulian tradition.

The Lower Palaeolithic sites or occurrences have been reported from most of the parts of India where habitat was favourable for prehistoric man. However, due to the following factors it is difficult to make any precise typo-technological comparison of the artifacts of the reported sites from different parts of India.

1. The detailed accounts of the typologicial and technological features are not available for the sites reported.

2 Uniform typological scheme has hardly been followed by analysts for classification of artifacts, particularly in the case of the Lower and the Middle Palaeolithic artifacts.

3. Most of the reported and published Lower Palaeolithic sites (occurrences) are secondary in context.

4. Lack of chrono-stratigraphic sequences of different tradition of the Lower Palaeolithic sites/occurrences.

5. The available collection of artifacts are hardly based on controlled sampling.

6. Lack of uniform terminology for different technical attributes.

In view of the above constrains we propose to compare our artifacts with those of the primary context excavated sites and also with those which have been analysed by the present researcher. The sites compared are Hunsgi, Bhimbetka-IIIF-23, Bhimbetka-IIIF-24, Adamgarh, Singi Talav-1, Indola-ki-Dhani, Chhatarpalia, Ramgarhwa, Koskangarha, Hatwa-I, Sihawal and Patpara-I. Due to obvious reason the comparison is primarily based on qualitative frame.

Hunsgi. The site of Hunsgi ($16^0\ 27'$ N; $76^0\ 31'$ E) is in Gulbarga district of Karnatka. It is situated on the bank of a narrow seasonal stream known as Hunsgi nala which meets the Krishna river about 35 km down stream. It is an oval shaped valley. K. Paddayya identified 13 Lower Palaeolithic occurrences in this valley and ultimately, after several trial diggings, he brought to light one Lower Palaeolithic occupational floor (Paddayya, 1977). About 291 artifacts fashioned mainly on lime stones were collected from the excavation of a trench (final) measuring about 9×7m. The shaped tools (109) consist of choppers (9), handaxes (18), cleavers (28), knives (14),

picks (8), polyhedron (10), spheroid (4), scrapers (15), backed tool (1) and flakes with prepared butt (2). Out of shaped tools handaxes, cleavers, knives and scrapers are the main tool classes constituting about 68% (75). Paddayya placed this site in the Early Acheulian tradition on the basis of the use of hard hammer and presence of choppers, picks, polyhedrons and knives. In the absence of detailed data of different attributes, no precise comparison is possible. However, considering the facts that ovate, elongate ovate and triangular handaxes, and quadrilateral cleavers are also present in the inventory of tool kits (Paddayya, 1977 : 344-55) and tools are fashioned commonly on lime stone which produces relatively deep scars even by using soft hammer. The assemblage may, perhaps, better be placed into the Upper (late) rather than Early (Lower)/Middle Acheulian tradition. More or less similar inference can also be drawn from the work of Semans regarding the comparative analysis of metrical attributes (1981 : 21-22). In view of these observations the site of Hunsgi seems to be closer to the Lower Palaeolithic sites of our study area, though they belong to different facies of the late (Upper) Acheulian tradition.

Further, Paddayya opined that the climate was more or less similar to what present today in the valley—open grassland vegetation. Is it the reason why Hunsgi assemblage has higher proportion of cleavers ? (cf. Joshi, 1969-70).

Bhimbetka-III F-23. The site of Bhimbetka (22° 50′ N; 77° 37′ E) is located on the northern margin of the Vindhyan Hill in Raisen district of Madhya Pradesh. Bhimbetka-III F-23 is one of the largest rock-shelters on the Bhimbetka Hill, it opens to the south. This rock shelter was excavated by V. N. Misra with the assistance of a number of scholars (1975-76 : 13-36). The excavation has exposed eight layers. Out of these eight layers only the lower three (i. e. 6, 7, and 8) have brought to light Acheulian assemblages. The main shaped tools are handaxes, cleavers, scrapers, knives (natural and backed) and other non-bifacial tools comprising about 31.9% (1501) of the total assemblage. Though the handaxes and cleavers together form a small component of shaped tools (11.9%), however, the scrapers and other non-bifacial tools made on flakes predominate the group of shaped tools in different layers (cf. Misra, 1975-76 : Tables 1-6). Further, it may be observed that though the advance types of bifaces like ovate, elongate ovate and triangular and sub-triangular handaxes and quadrilateral cleavers are present, but the predominance of non-bifacial tools fashioned on flakes associated with advance tool types, probably provide a different character to these assemblages. These artifacts are fashioned on quartzite. All these features suggest, as has already been opined by Misra, a Late/terminal Acheulian tradition. Contrary to Bhimbetka-III F-23, the advance types of non-bifacial tools are absent in our study area. In the light of above observations the Lower Palaeolithic tradition of Bhimbetka-III F-23 seems to be different and chronologically later than that of the Satna district.

Misra has presented the classified raw data in such an excellent format of figures and tables that it could conveniently be utilised in different perspective by future workers. Taking the advantage of published figures and tables (Misra, 1975-76) an attempt has been made to infer about the subsistence activities of the inhabitants of Bhimbetka (III F-23) rock-shelter. For this purpose due to obvious reasons the depths from 121-125 cm to 166-170 cm; 171-180 cm to 201-210 cm ; 211-229 cm to 246-250 cm ; 251-255 cm to 286-295 cm and 296-305 cm to 356-365 cm have been grouped as layer 6, layer 6-7, layer 7, layer 7-8 and layer 8 respectively. These layers consist of 800, 438, 131, 87 and 45 artifacts respectively. The percentage of handaxes, cleavers, scrapers and knives in layers 6 ; 6-7 ; 7 ; 7-8 ; and 8 is 2% (16), 5% (40), 35.2% (282) and 8.20% (66) ; 3.6% (16), 13.2% (58), 30.4% (133) and 11.18% (49) ; 4.6% (6), 12.2% (16), 21.4% (28) and 14.5% (19) ; 3.4% (3), 16.1% (14), 28.7% (25) and 24.1% (21) ; and 6.7% (3), 15.5% (7), 26.7% (12) and 11.1% (5), respectively (Table, 30). The proportional analysis *chi-square* test at 5% level of significance and given degree of freedom suggests that the tool kit (handaxes, cleavers, scrapers and knives) of layer 6, significantly differs from the tool kit of layers 6-7, 7, 7-8 and 8. Moreover, the proportional analysis within each assemblage, except that of layer (8), suggests that scrapers were the dominating tools of each assemblage and they significantly differ from cleavers and handaxes on the one hand and the cleavers from handaxes, on the other hand. In contrast, the assemblages of layer (8) do not show any significant difference between tool classes. However, indeed there is a clear cut sample ratio (size) difference between the assemblages. In the absence of data regarding the total volume excavated in each layer the proportional adjustment for the same could not be computed. It is, therefore, only a tentative inference can be made regarding such differences by using the tool-types as an important factor in determining the main activity for the means of subsistence.

Misra (1975-76) has rightly observed that this rock-shelter would have been a habitational-cum-factory site. It was, perhaps, because of this fact the shelter has quite a large range of tool types. In the beginning (layer-8) it seems that handaxes and cleavers played an important role along with other shaped tools, but later with the introduction of levallois elements they gradually, began to loose their importance and, in the end, layer-6, handaxes completely lost their central place in the tool kit. Right from the layer-8 the principal activity for means of subsistence would have been gathering as revealed from the presence of relatively high proportion of cleavers, side scrapers, notches, denticulate, abrupt retouch pieces and truncated flake-blade (cf. Binford, 1969). But the presence of handaxes and end scrapers in each layer and inclusion of levallois elements like levallois points, pseudo-levallois points from the layer 6-7 and onwords suggests that the basic means of subsistence i.e. gathering might have been supplimented by hunting activities as well. It seems that there was a change in tendency towords the hunting techniques and behaviour of the inhabitants. This translucent

picture of changing episodes becomes transparent when we compare the assemblages of layer-6 and layer-8.

Bhimbetka-III F-24. The rock-shelter of Bhimbetka-III F-24 situated close to Bhimbetka-III F-23 was excavated by V. S. Wakankar (1973 : 23-33). Here, the excavations in two trenches I and II, each measuring about 3×2m, have brought to light Acheulian assemblages from the lower most archaeological deposits. The artifacts are mostly made on quartzite. The percentages of shaped tools in the trench I and II are 35.8% and 22.9%, respectively. The remaining artifacts in each trench are unmodified waste comprising cores and flakes. Of the shaped tools, the percentage of handaxes, cleavers, scrapers and other tools in trench I, and II read 39 9%, 39.9%, 17.26% and 3%, and 21.2%, 30.9%, 47.9% and 0%, respectively (Wakankar, 1973 : 23-33). However, Misra has pointed out that blades and levallois flakes are also present with ordinary flakes (Misra, 1975-76 : 29). The combined testimony of these two trenches show that bifaces in general and cleavers in particular are dominant tools. It seems that Bhimbetka-III F-24 is close to Bhimbetka-III F-23 and probably, closer to layer 6-7 of Bhimbetka-III F-23 as grouped in this work. The high percentage of unmodified waste (cores and flakes) in both the trenches may suggest habitational-cum-factory site nature to the site. Like Bhimbetka-III F-23, Bhimbetka-III F-24 also differs with the concerned sites of the study area, belongs to Late/terminal Acheulian tradition, while the sites of Satna district belong to Upper (late) Acheulian tradition and have no levallois element.

Adamgarh. The site of Adamgarh (22° 45′ N ; 77° 43′ E) about 30 km south of Bhimbetka and about 2 km south of the town of Hoshangabad was excavated by R.V. Joshi and M.D. Khare. These scholars excavated a number of trenches, but data is available only for two trenches i.e. ADG-6 and ADG-7 (Joshi 1979:157-73).[1] Most of the artifacts are made on quartzite and fine grain sandstone. In trench ADG-6 handaxes and cleavers have almost similar frequency i.e. 9 and 8 respectively, and both are absent in trench of ADG-7 (Joshi, 1979 : 169). A number of shaped tools are in unfinished stage, Joshi classified these as Lower Palaeolithic sites. Especially at factory site, where a good number of unfinished tools are present one should be very careful about identification of tools. Of the illustrated nine choppers at least three (Fig. 7 : no. 4,5,9) seems to be unfinished handaxes (Joshi, 1979 : Fig. 7). Moreover, Joshi also reported some well finished tools with high level of workmanship. The site seems to be a factory site of late Acheulian tradition. In comparison to the site of our study area it closely resembles with the site of Naru Hill, a factory site in particular and, with other sites in general.

Singi Talav-1. It is a salt lake site, located south of Didwana (27° 24′ N, 74° 35′ E), a small town in Nagaur district of Rajasthan in the eastern part of the desert. The site was excavated by V. N. Misra and his team of scholars for two field seasons 1980-81 and 1981-82 (Misra, et.al. 1982 ; Gaillard, et.al. 1983). Artifacts are mainly fashioned on quartzite and quartz. On the basis of massive and thick handaxes, choppers, chopping tools, polyhedrons and use of stone hammer (hard), scholars are of the view that the site of Singi Talav-1 belongs to Early (Lower) Acheulian tradition. Moreover, it has also been interpreted as a manufacturing-cum-habitational site. On the basis of the typo-technological grounds and other features reported by Misra the site of Singi Talav-1 shows differences with those of the Satna district. In our study area the bifaces are well made and show a high level of workmanship with advance types of bifaces and low proportion of choppers, chopping and polyhedrons. In the absence of detailed accounts of other relevant attributes any exhaustive comparison is hardly possible. However, it may be mentioned that the study is still in progress, the real nature of site would become more clear after study is completed.

Besides the problems raised by Misra (Misra, et.al, 1979-80, 1980,1982), at least one more question needs explanation. Why is there a low frequency of cleavers in relation to handaxes as revealed from the excavations and explorations conducted in the region ? If we accept Joshi's hypothesis regarding the significance of cleavers (Joshi, 1969-70), then there are at least two possibilities. First, a remote possibility is that some sites of the region are perhaps, of the earlier phases of Acheulian tradition. Second, a majority of sites are of the Upper (late) Acheulian tradition and the concerned region during the period, was probably, poorly vegetated with low rainfall. However, the possibility of behavioural differences and variation in activities for the means of subsistence during the period of the Upper (late) Acheulian tradition in the region can not be minimized.

We hope that this region will throw a welcome light on the various problems associated with Acheulian tradition in Indian context like : chrono-stratigraphic sequences of Acheulian traditions, typological sequences and variability within the same tradition. The reason of such an optimistic view is that a multi-disciplinary work has been initiated and very fruitful preliminary results have already been obtained.

Indola-ki-Dhani. The site is situated about 2 km to the south of Singi Talav-1. This site was also excavated by V.N. Misra and his team (Misra, et. al. 1982 : 72-86). The assemblage recovered in the horizon-2 consists of 6.8% (30)

shaped tools. Shaped tools comprise 2 (6.7%) in-complete handaxes, 7 (23.3%) points, 7 (23.3%) scrapers, 6 (20%) choppers, 3 (10%) chopping tools, 3 (10%) ployhedrons and 2 (6.7%) knives. About 77% out of unfinished waste comprise flakes and chips. Artifacts are made on quartzite and quartz. The site has been identified as a factory site of Late Acheulian tradition primarily on the three factors. First, there is a high proportion of points and scrapers; secondly, relatively small size of tools from those of Singi Talav-1; and thirdly, high proportion of unmodified flakes and chips (waste). Lack of detailed information of other relevant attributes of tools restrain us to compare and interpret in depth. The presence of high percentage of chopper, chopping and points and the absence of cleaver at the site show some differences with the sites of the Satna district, where the percentage of choppers is very low and the tools like chopping and points are absent. Thus, it can be tentatively proposed that both, the site of Indola-ki-Dhani and sites of our study area may fall into different facies of the Upper (late) Acheulian tradition.

Belan valley. A large number of Stone Age sites/occurrences have been located by the Department of Ancient History, Culture and Archaeology, University of Allahabad in the valley of Belan river, Uttar Pradesh, under the director-ship of late Professor G.R. Sharma (Sharma, 1973, 1980 : 83). The huge collection of artifacts is extremely rich for the study of typo-technological features. Since the collection is not based on controlled sampling procedure, therefore, any specific comparison of these materials with those of the Satna district collected by probability sampling procedure is hardly possible. However, the following observations on their general comparison may be made which are based on the analysis of artifacts of only three sites of the Belan valley done by the present researcher (Sinha, n.d.b). The sites analysed are Chhatarpalia, Ramgarhwa and Koskangarha[2]. Artifacts collected at these three sites are fashioned on quartzite. The percentage of shaped tools in Chhatarpalia, Ramgarhwa and Koskangarha is 31%, 35.5% and 38.8%, respectively. Barring the assemblage of Chhatarpalia, which has only four modified artifacts, the rest two assemblages are devoid of modified artifacts. Handaxes, cleavers and scrapers are the main tool classes of these assemblages. Although, two choppers are present in the collection of Chhatarpalia. Mostly, deep scrapers are present on these artifacts, suggesting thereby relatively more use of hard than soft hammer. The handaxes and cleavers of these assemblages are also represented by some advance types like ovate, elongate ovate, triangular handaxes and quadrilateral cleavers, though in low proportion. Typologically the artifacts of these sites seem to be broadly similar to those of the Satna district. Technologically there are some differences. The tools of the Belan valley are cruder than those of our study area. Like the sites of our study area, on the whole, the sites of

Chhatarpalia, Ramgarhwa and Koskangarha of the Belan valley may be placed in the Upper (late) Acheulian tradition. But, on fine typo-technological consideration the sites of the two regions belong to different facies.

Son Valley. In the Son valley a number of Stone Age sites/occurrences have been discovered by the Department of Ancient History, Culture and Archaeology, University of Allahabad in the Sidhi district of Madhya Pradesh under the supervision of late Professor G.R. Sharma (Sharma, 1980 : 93). Like the Belan valley here too collection was not made by controlled sampling procedure. Out of about 47 sites/occurrences, the present resercher has analysed three sites—Hatwa-I, Sihawal and Patpara-I[2] (Sinha, n.d.b). The assemblages of Hatwa-I, Sihawal and Patpara-I consist of 177, 151 and 104 artifacts, respectively. The percentage of shaped tools in Hatwa-I, Sihawal and Patpara-I is 97.1% (140), 60.9% (92) and 76.9% (80), respectively. The assemblages of Hatwa-I has no modified artifact while those of Sihawal and Patpara-I comprise of 8.7% (13) and 2.9% (3), respectively. The main tool classes of these assemblages are handaxes, cleavers, scrapers, knives and picks. Artifacts of these assemblages are fashioned on quartzite, though a few artifacts on lime stone and chert are also present. These assemblages consist of a high proportion of ovate, elongate ovate and triangular handaxes, and quadrilateral cleavers are more common. The presence of deep and shallow scars suggests the use of both hard and soft hammers. The typo-technological features suggest that these assemblages can be associated with the Upper (late) Acheulian tradition. Clark and Sharma (1983a : 261-79) also opined that Acheulian tradition of the Son Valley belongs to the Upper (late) Acheulian period. The presence of a high proportion of ovate, elongate ovate and triangular handaxes and quadrilateral cleavers in the assemblages of both the regions, the mid Son Valley and the Upper Tons valley, shows a closer resemblance in the facies of the Upper (Late) Acheulian tradition.

In view of the above comparison, discussion and present state of our knowledge of the Lower Palaeolithic culture, especially of the Acheulian tradition, we can tentatively group the Lower Palaeolithic sites in Indian context into four main traditions. Obviously, in the absence of chrono-stratigraphic sequences this grouping is based merely on the typo-technological comparison.

i. Early (Lower) Acheulian tradition-i.e. Singi Talav-1 (?).

ii. Middle Acheulian tradition-not available of the examined sites.

iii. Upper (late) Acheulian tradition-i.e. Hunsgi, Adamgarh, Indola-ki-Dhani, Chhatarpalia, Ramgarhwa, Koskangarha, Hatwa-I Sihawal, Patpara-I, Nakzharkhurd, and sites of present study

area like- Sharda Temple-I, Sharda Temple-II, Sharda Temple-III, Sharda Temple-IV, Naru Hill, Sagatha, Belhata-II and Tikura.

(iv) Late /terminal Acheulian tradition i.e. Bhimbetka-III F-23 and Bhimbetka-III F-24.

However, due to obvious reasons it would be better to regroup these four traditions into three. The first two traditions i.e. Early (Lower) and Middle Acheulian should be grouped under earlier Acheulian tradition-Group-1 and the remaining two the Upper (Late) Acheulian and Late/terminal Acheulian traditions as Group-2 and Group-3, respectively. The three fold divlsion is, perhaps, advantageous in the absence of chrono-stratigraphic sequences and the Middle Acheulian sites. The site of Singi Talav-1 needs in depth study to identify its nature and tradition.

Chronology

In the absence of radiometric dates for the alluvial formations of the Upper Tons valley, independent chronology is not possible. Fossil remains were not also encountered in the course of field work. Generally, in such a situation, the remedy left before archaeologists is to build a relative chronological sequence of various formations on the basis of available archaeological materials and their comparison with other stratified and, if possible dated archaeological materials. By adopting the same method we attempt to build a relative chronology of the alluvial formation of the Upper Tons valley primarily on the basis of comparative study of the stone artifacts extracted from the sections, collected at the various sites, and in turn their comparison with those from the other river valley where chronological time scales have been proposed by scholars on more secured grounds. Among these mention may be made of Sankalia (1974 : 113-39, 1979 : 20-24), Misra (1967), Misra et.al. (1979-80, 1980, 1982), Allchin, et.al. (1978 : 305-30), Khan (1968), Misra (1977 : 61-64), Williams and Keith (1983 : 9-21), Adamson, et.al. (1980), Joshi (n.d.), Prasad (n.d.), Khatri (1982), Sharma (1973, 1975), Badam (n.d.), Agrawal (1981), Agrawal, et.al. (n.d.). Besides some radiometric dates now available for the Lower Palaeolithic period of India have also been utilized such as dates for the pebble tools from the Pir Panjal site reading about 0.7 m years B.P. i.e. of Middle Pleistocene age (Agrawal, et.al. (n.d.), for the Acheulian artifacts from Saurashtra reading about 0.17 m yrs B.P. for late Middle Pleistocene deposit (Joshi, n.d.).

In the Upper Tons valley we are getting artifacts of the Upper (later) Acheulian tradition from the Upper part of the Lower member of the Sharda formation which is capped by its Upper member. The Upper member of the Sharda formation is, archaeologically, a sterile deposit. The second

formation, that overlies Sharda formation probably after a considerable time gap as indicated by the features of unconfirmity is Mansava Ghat formation. The lower part of the lower member of the second formation consists of mixed artifacts of the Lower and the Middle Palaeolithic period. However, artifacts of the Middle Palaeolithic period are relatively fresh to those of the heavily rolled Lower Palaeolithic artifacts. This suggests that the Lower Palaeolithic artifacts were redeposited along with the Middle Palaeolithic artifacts. The third formation, Satari formation, rests on the non implementiferous upper member of the Mansava Ghat formation again probably after a considerable time gap. It is associated with the late Upper Palaeolithic artifacts overlain by an archaeologically sterile deposit of Madhogarh formation i.e. fourth formation. The succeeding two formations i.e. Sagoni and Rampur, have yielded artifacts of the Mesolithic period. In the light of these findings and their comparative evaluation a tentative chronology of the Upper Tons valley would appear to be as follows :

The Sharda formation bearing Upper (late) Acheulian artifacts might have been formed during the period ranging from the late Middle to the early Upper Pleistocene age. The Mansava Ghat formation comprising the Middle Palaeolithic artifacts can be placed into the Upper Pleistocene period. The third deposit i e. Satari formation having artifacts of the late Upper Palaeolithic period may be associated with the Terminal Pleistocene. The last two formations (i.e. Sagoni and Rampur), both associated with microliths can be placed into the early to middle Holocene and middle Holocene, respectively. The Madhogarh formation, which lies between the Satari and Sagoni formations, can be placed between the end Pleistocene to early Holocene.

On extrapolation of the radio metric dates for the Son and the Belan valleys (Williams and Keith, 1983 : 9-21 ; Sharma 1973, 1975 ; Mandal, 1983) in particular and other valleys in general (Agrawal and Kusumgar, 1974 : 44 ; Agrawal, et.al. n.d.; Misra, 1977 : 61-64 ; Joshi, n.d.) the following tentative dates may be assigned to different formation of the Upper Tons valley.

(a) Sharda Formation $\geqslant$100,000 (Late Middle to Early Upper Pleistocene).

(b) Mansava Ghat Formation $<$1,00,000 to—30,000 (Upper Pleistocene).

(c) Satari Formation-c. 30,000 to c. 12,000 (Terminal Pleistocene).

(d) Madhogarh Formation $>$12,000 (End Pleistocene to Early Holocene).

(e) Sagoni Formation c. 9,000 (Early Holocene to Middle Holocene).

(f) Rampur Formation 5,000 (Middle Holocene).

Subsistence activities

In this section an attempt has been made to infer about the nature of sites, as well as the dominating activity and primary means of subsistence at the concerned sites. It is based on the proposed hypothesis and model (see chapter-2) and analysis of findings (see chapter-6).

The "in between sites analysis" revealed that there were two groups of sites—a relatively long and short occupational. The former group includes the sites of Sharda Temple-I (ST-I), Sharda Temple-II (ST-II), Sharda Temple-III (ST-III) and Sharda Temple-IV (ST-IV). While the sites of Naru Hill (NRH), Belhata-II (BHT-II),Sagatha (SGT) and Tikura (TKR) fall in the latter group. Barring the sites of NRH and TKR, which will be discussed later, all the remaining six sites would have been habitational site. At ST-IV, probably, some tool manufacturing was also done, therefore, it may be identified as habitational-cum-factory site.

The Coefficient of correlation of the complete tool kits testified the results drawn from stage-I and II of the proposed model. It suggests the dissimilarity of about 52.5% between Tikura and the rest of seven sites. At 37% dissimilarity there are three groups i.e. groups of ST-III, ST-IV and TKR (Fig 95). Moreover, ST-I, ST-II and NRH are linked with ST-III group at 26%, 25% and 15% of dissimilarity, respectively. However, it seems that the link of ST-I with ST-III is mainly because of former's intermediatery position. The group of ST-IV consists of BHT-II and SGT and these two are linked with ST-IV at 13% and 20% of dissimilarity, respectively.

On the basis of statistical model proposed in this work, there are four types of main tool kits—handaxe dominating (ST-II), cleaver dominating (ST-IV), scraper dominating (TKR) and common tool kit (ST-I, ST-II, BHT-II, SGT). In view of the hypothesis the proposed dominant primary means of subsistence at the four sites - ST-I, ST-II, BHT-II and SGT was probably hunting and gathering both. At the three of the four sites gathering activity was relatively prominent than hunting i.e. ST-I, BHT-II and SGT while at the fourth site i.e. ST-II hunting activity was prominent. The primary means of subsistence at ST-III and ST-IV would have been hunting and gathering, respectively.

The main tool kit of TKR significantly differs from those of ST-IV and ST-III, it is dominated by scrapers. Intra-site proportional analysis suggests that scrapers significantly differ from cleavers. In view of the discussion and hypothesis proposed by the scholars such as Clark and Hayens (1970), Clark (1970), Binford (1972), Freeman (1975), Klein (1978) and Keeley (1980 : 169), and the analysis of tools collected at the site of TKR, it seems to be a butchering site. But, in the absence of animal bones any precise inference

is hardly possible. However, the observations made by Issac about scavengers (1968 : 258), open air unsealed nature of the site and its 52.5% dissimilarity with other sites of the region indicate some what different activity at the site.

The presence of a good number of unfinished and rejected tools, and a low proportion of finished tools at the site of NRH suggests that it would have been a short occupation-factory site. There is no significant difference between its main tool kit and those of the other sites. The dissimilarity between NRH and ST-III is about 15% and is linked with the latter site. It can, therefore, be inferred that it would have been perhaps, a factory, where almost all types of tool classes were being manufactured.

To sum up, it may be observed that there were differences in the basic means of subsistence in between the sites, but both the activities hunting and gathering were in practice. However, the proportion of gathering activity was, probably, more than hunting at the time of occupation of these sites. For such variation atleast two possibilites can be proposed. First, there might have been seasonal variations during the time-span of occupation, such as dry summer, wet summer, transitional and winter seasons. If this was the situation, then obviously, the proportion as well as locational availability of animal and plant resources would have varied seasonaly. Prehistoric man, therefore, adapted such changes either by adjusting the tool kit and/or by abandoning the site for the better location. The second possibility relates to the behavioural differences among the inhabitants of these sites.

In spite of the fact that the concerned sites are open air and unsealed and also that the interpretation regarding the primary means of subsistence is not based on the micro-wear analysis, the nature and primary mean of subsistence as inferred above is hardly beyond the range of possibility. This is because of the fact that hypothesis and model on which the analysis and inferences are based, have been built up after taking into account various important factors as the evidences from stratified archaeological context, ethno-archaeological data, experimental archaeological data, both flint-knapping experiments and micro-were analysis etc. We could not infer about other activities such as food processing, skinning, hide scraping, manufacturing of bone and woodden tools, etc., which would have been, perhaps, carried out at most of these sites. These short-comings are due to the fact that the study is mainly based upon the morphological functional analysis. Obviously such functional analysis has its limitations. Some of these limitations have been discussed below.

Limitations of morphological analysis

Limitations associated with the morphological functional analysis can be focused by making a brief account of methods and techniques used in

micro-wear functional analysis, as well as scope of micro-wear analysis. A micro-wear functional analysis is based upon various microscopic features. Some of important features are the study of (1) micro-scars like step, circular/lunate, feather, triangular, scaliriform, etc.; (2) whether micro-scars are deep and/or shallow and their location ; (3) type of striations ; (4) location and orientation of striations ; (5) type of polish ; (6) location and distribution of polish ; (7) morphological features of artifacts ; (8) edge angle ; (9) type of raw-material etc. These microscopic features are generally observed either under low or high magnification. However, to go beyond the type of polish to infer about particular material needs microscopic examination at various magnifications as has been suggested by the present researcher (Sinha and Glover, 1984; Sinha, n.d.c). These microscopic features are usually compared with replicated experimental artifacts. Thereafter, the final interpretation and conclusion are normally made about activities and worked material. Hence, one can visualise that how much detail microscopic analysis is involved to infer precisely about different activities and behaviour of inhabitants at the site. However, the exhaustive observations and labour become fruitful while dealing with the scope. Following the micro-wear analysis a number of scholars such as Semenov (1964, 1970), Nance (1971), Keeley (1974, 1976, 1977, 1980, 1982), Tringham, et.al. (1974), Peterson (1974), Clark and Prince (1978) Cahen, et.al. (1979), Kamminga (1979), Hayden (1979), Odell (1979), Vaughan (1979, 1981), Cahen and Keeley (1980), Korobkova (1981), Moss and Newcomer (1982), Meeks et.al. (1982), Moss (1983), Sinha and Glover (1988), Sinha (1986, 1989) have not only inferred the functions of stone tools but also of economics and behaviour of prehistoric man. The results of micro-wear researches have clearly demonstrated that the following types of interpretations can be made on justifiable and scientific grounds from the informations retrieved by systematic micro-wear analysis, the problem has been dealt in details by the present researcher (Sinha, 1985).

1. About the technique of manufacturing stone and bone implements.
2. About the use of different stone artifacts.
3. About the proportion of motional activities.
4. About the proportion of worked material, even in the absence of floral and faunal evidences.
5. About the proportion of one particular tool used on different worked material.
6. About the proportion of vegetative and non-vegetative diet.
7. Whether prehistoric man was making bone and wooden artifacts or not.

8. About the standard of craftsmanship.
9. Whether plants used were cultivated or wild.
10. Whether tools were hafted or not.
11. About the types of hafting.
12. About the efficiency and/or preference of tools used for one particular activity.

Such type of interpretations are hardly possible from the informations available by morphological functional analysis. However, the present researcher's hypothesis about the primary means of subsistence in the present work is based upon the evidences obtained from the stratified archaeological context, ethno-archaeological data, experimental archaeologial data-both micro-wear analysis and flint-knapping experiments. The inferences, thus, drawn of the primary means of subsistence at the sites are, perhaps, not beyond the range of possibility. Moreover, to retrieve microwear data from the artifacts collected from open air, unsealed sites is practically very difficult. In spite of the limitations of morphological functional analysis it is useful for the open air, unsealed sites to infer about the primary means of subsistence and to some extent behaviour of prehistoric man, provided other evidences are also taken into account.

Settlement Pattern

The data collected in the course of field work and laboratory analysis are not adequate to infer precisely about the settlement pattern of Lower Palaeolithic inhabitants of study area. However, with the help of the available data some preliminary inferences of the settlement pattern during the Lower Palaeolithic period may be made.

Mostly, the sites are located either on the low/ high relief weathered rocks and either close to the nalas or rivers. It is interesting to observe that all the large, relatively long occupational sites are close to the nalas than the rivers and moreover close to the chain of hills. Contary to this the small sites relatively of short occupation are situated invariably close to the rivers and away from the chain of hills, rather in open surroundings, except the site of Naru Hill (NRH), which is located on the northern foot of the Naru Hill. These sites are Belhata-II (BHT-II), Sagatha (SGT) and Tikura (TKR). It has also been noticed that the factory site (NRH) and the large sites relatively of long occupation are close to the source of raw material. These observations raise two important questions regarding the settlement pattern during the occupational period. First, what is the relevence of such dichotomy of the distribution pattern of the sites ? Second, why are the small sites

with short occupation close to the rivers and the large sites witn relatively long occupation close to the nalas ? In view of our present state of knowledge about the prehistoric man, at least two explanations can be proposed for these questions.

The small sites of short occupation were, perhaps, temporary camp and the large sites of relatively long occupation were probably base camp. Obviously, the principal activity at the two types of camps varied. The temporary camp was, probably, used mainly for collecting the means of subsistence. Hence, a small group, perhaps, used to go for hunting and/or gathering expeditions. While the base camp, more likely, was used for food processing and artifacts manufacturing. However, the overlapping mixed activities can not be ruled out.

Why are the two types of sites situated in two different physiographic locality, the base camps nearer to hills and nalas and the temporary camps closer to river ? It may be argued that the advantage in occupying large sites for relatively long duration closer to hills and nalas was because of the availability of raw material, security and other resources. Similarly the existence of factory site may also be explained if it is assumed that the production of artifacts at most of the large sites was probably not commensurate with the demand of artifacts needed for hunting/gathering expedition, therefore these were manufactured also at some favourable places. The explanation is quite reasonable indeed. But how to explain the situation and need of the temporary camp ? Why was it needed at all when the inhabitants could have lived closer to hills and nalas where practically almost all resources were available ? This however, did not happen. The existence of temporary camps on the river is a reality. Why is it so ?

The explanation of the above question seems to have been governed by the relationship of the following three factors :

1. Seasonal variation in the climate.

2. Secured and favourable locality.

3. Higher and more stable potentiality of the resources.

Of these, the role of seasonal change in climate and its impact on the inhabitants of base camp is quite logical. Usually during dry summer it has been observed that water level of nalas and rivers goes down, the vegetation becomes thiner particularly on the hills and around nalas, and animals also often temporarily move towards rivers for means of supporting life—food and water. Though, animals generally do not make permanent shelter close to rivers, however, they frequently visit the rivers for food and water. It was, probably, the temporary shifting in the venue of food resources from hilly

locality to river that might have caused the inhabitants of the base to move nearer to river for a short duration. On return of the favourable season they probably used to reoccupy the base camps being more secured with high potentiality of stable food resources and raw material for manufacturing of stone artifacts leaving behind the remains of temporary camps on the river bank.

The explanation put forward may also be refined by using the behaviour of present climatic variations, if it is assumed that the present variations in wind directions, temperature, and seasons are broadly similar to those of the late Middle Pleistocene. The assumption is based on the results of the study of the alluvial stratigraphy of the Upper Tons valley regarding the climatic changes. Clark (1964) and Paddayya (1977) also come to the similar interpretation for the climate of their respective regions.

The duration of present dry summer, pre-monsoon season, is from March to May. During this period the direction of wind remains from south-west to east, the temperature reads about 30°C. It is quite likely that the habitat of the large sites would have been unfavourable during this season particularly because of scarcity of food resources. The protection to their shelters (?) if any, would have also been affected by wind. These factors might have caused to their movement during the peak time of the season towards the rivers for a short duration. The most favourable season for the large sites or base camp would have been winter and post-monsoon period which range from October to January. The wind direction and temperature in this season are approximately from north-west to east and 20°C respectively. In this season plenty of food materials both plants and animals would have been available and their shelter (?) would have also been protected from the wind through the chain of hills located to the north-west of the base camps. In the Monsoon i.e. from June to September they might have moved to rock-shelters or caves on the hills because of heavy rains, wind and other obvious reasons. Though, no exploration was made on the neighbouring hills, however, such possibilities cannot be cornered in the light of the discoveries made at Bhimbetka and Adamgarh rock-shelters.

Evaluation of methodology adopted

One of the aims of the regional survey was to obtain a representative picture of the inventory of the Stone Age cultures. Contrary to the traditional method of exploration, probability sampling procedure was adopted. The merit and demerit of this procedure have been dealt in detail in chapter-2 and needless to repeat here.

This procedure not only brought to light the inventory of the Stone Age

cultures in the region but also provided data for mathematical formulas to compute the parameter of the mean range of the expected number of sites and artifacts in the sampled population The probability sampling procedure is the best known method so far for such type of work, the same has been tested elsewhere too (Sinha, 1988).

According to Schiffer there are four kinds of processes that influence the formation of archaeological sites (Schiffer, 1972, 1976 : chapter 3, 4, 9). These four processes are the result of biases either of human and/or natural agencies. In the following paras a brief description is being given of the observations made in the course of field and laboratory work regarding to the processes. Attempt has also been made to show that how and to what extent the probability sampling procedure spontaneously minimises the biases.

The first process deals with 'systematic-archaeological context (cultural deposition or S-A process). It has been noticed that distribution of artifacts at the sites generally shows no selective discarding of the artifacts, though the element of discarding is often involved. The application of either simple or stratified random sampling procedure in the collection of artifacts ensures the elimination of the biases to a considerable extent. This is because of the principle involved in the procedure itself. Here, sampling units are treated in an undifferentiated manner and are selected through random number table. Hence, every combination of units has an equal probability of being selected.

The second process concerns with the 'archaeological-systematic process' (A-S process). The examples of the process were found at two of the sites—Sharda Temple-I and Rampur-II. The site of Sharda Temple-I, a Lower Palaeolithic site was reoccupied by the Mesolithic man (Sharda Temple-Ia). There was hardly any clue regarding the reutilization of Lower Palaeolithic artifacts by the later intruders of the Mesolithic period. Though, the possibility of reutilization of some of the earlier artifacts in form of stone hammer by the latter occupants can not be ruled out. The other example is of the discovery of a recently broken cleaver on the top of the accumulated stone pieces prepared by the quarry workers at the site of Rampur-II (Plate XXXII). The biases generated through the process may be identified and minimised by using probability sampling procedure.

The third and the fourth processes are—'archaeological-archaeological' (disturbance or A-A process) and systematic-systematic (reuse or S-S process) processes. The example of the former process was noticed at the sites of Sharda Temple-II, Sharda Temple-IV, Naru Hill and Rampur-II, (See Chapter-4). These sites were marginally disturbed either by natural agencies or Civil Engg. department. The stratified random sampling procedure was used to collect artifacts at these sites which considerably minimised the biases caused generall

by such disturbances. There was no evidence for the systematic-systematic process of site formation in our study area.

The picture emerging from the above discussions shows that nearly all the four types of processes as opined by Schiffer do play an important role in the formation of archaeological sites involving lot of biases The most scientific remedy to minimise biases, both the human and the natural, rests with the planning and techniques to be adopted in the field survey. Besides other advantages as has been mentioned in chapter-2, its another important advantage is that it can also minimise those biases of human and/or natural agencies which influence the formation of archaeological sites

One more important point related to admixture of artifacts belonging to different culture and/or tradition needs discussion. It has been noticed that sometimes miniature bifaces of the Lower Palaeolithic assemblages collected from the open air, unsealed surface sites are separated from the assemblage family (Misra, et. al. 1982). It is, perhaps, based on the preassumption that the miniature bifaces belong to Middle Palaeolithic culture. But, curiously enough any reference is hardly made of the presence of allied characteristic features and elements of Middle Palaeolithic culture in the concerned assemblages. Why are the miniature bifaces not treated as component part of the Lower Palaeolithic assemblage itself, especially of late/terminal Acheulian tradition, when the presence of such pieces are reported from a number of Middle Palaeolithic sites, probably indicative of continuation of bifacial tradition. Furthermore, if miniature bifaces do not show any clear sign of disintegration of tool classes/types and if other element of Middle Palaeolithic culture is not present in such assemblages, then there is, probably, no point to isolate them from the Lower Palaeolithic assemblages merely on the ground of their being small (mini) in size. The presence of the miniature bifaces in such circumstances should be treated as an integral part of the Lower Palaeolithic assemblages.

Conclusions

In the following pages an attempt has been made to summarise the results of the work.

1. The use of probability sampling procedure and the strategy adopted in relation to the problems raised in this work proved highly rewarding. The said procedure is, perhaps, the most economical and precise scientific tool to estimate the inventory of archaeological sites and artifacts. It may be observed that by surveying only about 491.5 km² it could be possible to estimate the activities of the prehistoric man in the area of about 3145 km² being the sampled/target population.

2. Through the methodology and statistical model used in this work it can be possible to retrieve some dependable informations even of the open air unsealed sites, of the variability between the sites of similar culture and tradition, of the dominant activity regarding the primary means of subsistence, etc.

3. It appears that gathering activities probably, had an edge over hunting for the basic means of livelihood during the Lower Palaeolithic period.

4. It seems that for long occupation the Lower Palaeolithic homonids preferred to live nearer to the nalas and naturally protected areas where raw material, water and food resources were adequately available.

5. The presence of both deep and shallow scars with relatively irregular edge profile suggests the use of hard as well as soft fabricators.

6. The miniature bifaces should not be excluded from the membership of the Lower Palaeolithic assemblages merely on the basis of their small (mini) size.

7. It would be perhaps improper to assign any assemblage to earlier or later category merely on the basis of technological comparison without taking into consideration of the nature of raw material. In this respect the role of raw material is crucial.

8. The model for land-use proposed in this work provided us dependable rationale to infer about causes and effects of variability between the sites, primary means of subsistence and settlement pattern such as seasonal variation in the catchment area, behavioural differences, seasonal migration, organisational set up in form of base and temporary camps, lithic technology, etc. We hope, therefore, that it can be used as a skeleton of similar researhes in other regions as well.

9. On the basis of typology and technology of the artifacts the Lower Palaeolithic sites of the study area belong to the Upper (Later) Acheulian tradition. The associated ovate, elongate ovate and sub-triangular handaxes and quadrilateral cleavers show a closer affinity with the Acheulian facies of the Son valley but differ from those of the Late Acheulian tradition of the Belan and the Hunsgi valleys. Typo-technologically they are positively of the earlier tradition than those recovered from the Bhimbetka rock-shelters. In terms of geological time scale, the Lower Palaeolithic sites of the study area can be placed between the late Middle Pleistocene and the Upper Pleistocene.

Notes

1. Also published in Asian Perspective, 1966, Vol. VIII No. 1, 150-63.
2. The material is housed in the Departmental Museum.

LIST OF TABLE

Table

Table 30. Depth-wise representation of main tool classes of Acheulian industry in rock-shelter III F-23 at Bhimbetka, Madhya Pradesh.*

Depth in cm	Layer	Total Tools		Handaxes		Cleavers		Scrapers		Knives	
		n	%	n	%	n	%	n	%	n	%
121—125 to 166—170	6	800	53.3	16	2	40	5	282	35.2	66	8.2
171 - 180 to 201—210	6-7	438	29 2	16	3.6	58	13.2	133	30.4	49	11.2
211—229 to 246—250	7	131	8.7	6	4.6	16	12 2	28	21.4	19	14.5
251—255 to 286—295	7-8	87	5.8	3	3.4	14	16 1	25	28.7	21	24 1
296—305 to 356—365	8	45	3	3	6 7	7	15.5	12	26.7	5	11.1
Total		1501	100	44		135		480		160	

* This table is derived from the figures (Fig. 3,4) and Tables (Table 1, 2, 4, 6,) compiled by V. N. Misra (1975-79 : 17-25) after some appropriate adjustments as required in the present research. In this table the percentage of handaxes, cleavers, scrapers and knives in each layer is out of total tools present in that layer.

APPENDIX A

STATISTICAL FORMULAE

The statistical formulae used in this research work are as follows.

(1) *Sampling ratio* $= \frac{n}{N}$

where, n = Number of sample units to be investigated.

N = Total number of sampling units in the sampled population.

(2) *Standard deviatian* $(\sigma) = \sqrt{\frac{\Sigma d^2 - (\Sigma d)^2}{n-1}}$

where, d = Deviation of each interval mid point from the assumed mean.

n = Number of instances of variables being considered.

(3) *Standard error of sample mean of variable 'Y'* (σY) $= \left(\frac{S}{\sqrt{n}}\right) \sqrt{1-f}$

where, S = Standard deviation between units.

n = Number of units in the same sample

f = The sampling fraction (number of units in sample divided by total number of units in the population).

$\sqrt{1-f}$ = The finite population correction factor which adjust the estimates for small total populations (as population gets larger, f goes to 1).

(4) *Parameter mean range at 5% level of significance* $= \text{Mean} (\bar{X}) \pm (1.96 \times \text{standard error of the mean})$.

(5) *Artifacts density (artifacts/meter²)*

$$= \frac{\text{Total number of artifacts sampled in sampled units}}{\text{Area of the sampling unit} \times \text{total number of units sampled}}$$

(6) (i) *Analysis of variance* (F)

$$= \frac{\text{Variance between samples}}{\text{Variance within samples}}$$

(ii) *Degree of freedom* :

The number of degree of freedom for within the sample is—

$$n_2 = (N_1 - 1) + (N_2 - 1) + \ldots\ldots + (N_X - 1)$$

where, N = Number of items present in the samples.

The number of degree of freedom for between the samples is—

$$n_1 = (K - 1)$$

where, K = Total number of samples.

(7) (i) *Proportional Chi-Square test* (X^2)

$$= \frac{(a_1 b_2 - b_1 a_2)^2 N}{N_1 N_2 Na Nb}$$

where, a_1 = frequency of item in the sample 1.

b_1 = frequency of item in the sample 2.

N = Sum of total item in the samples 1 and 2.

N_1 = Total number of items in the sample 1.

N_2 = Total number of items in the sample 2.

$a_2 = N_1 - a_1$

$b_2 = N_2 - b_1$

$Na = a_1 + b_1$

$Nb = a_2 + b_2$

(ii) *Degree of freedom* $(n) = (R-1)(C-1)$

where, R= The number of rows.

C= The number of columns.

(8) (i) *Students 't' test* (t) $= \dfrac{\bar{X}_1 - \bar{X}_2}{\sqrt{e_1^2 + e_2^2}}$

where, $\bar{X}_1$= Mean of the item in the sample 1.

$\bar{X}_2$= Mean of the item in the sample 2.

e_1= Standard error of the mean in the sample 1.

e_2= Standard error of the mean in the sample 2.

(ii) *Degree of freedom* $= (n_1 - 1) + (n_2 - 1)$

where, n_1= Total number of the item in the sample 1.

n_2= Total number of the item in the sample 2.

The table value of 'F' ; 'X^2' and 't' were obtained from the tables published in *Mathematics of Statistics*, Vol. II by Kenney and Keeping (1951) and *Applied General Statistics* by Croxton, Cowden and Klein (1982).

SIGNIFICANCE OF SAMPLE SIZE

Generally, it is believed that for statistical analysis the sample size should be more than 100 items (artifacts). Though, in principle the statistical analysis can be performed even for single artifact, only the difference will be in the probability. Furthermore, the reliability of the results obtained from the statistical analysis of a biased sample containing one thousand artifacts is equally doubtful. However, there is no definite criteria to assertain sample size. The same has been opined by the statisticians—

> "It is not obvious how large N should be before we can regard the distribution of a statistic as practically normal even when we know that it is asymptotically normal. For some statistic including the arithmetic mean, a sample of 30 can usually be considered large; for other, such as the coefficient of correlation, a sample of 500 may be sufficient to ensure a good approximation to normality."
>
> (Kenney and Keeping, 1951 : 133).

Regarding the *chi-square* test Cochran opined that in some cases atleast, numbers as small as 1 may be permitted without seriously effecting the validity of the test (Cochran, 1936 : 207; quoted by Kenney and Keeping, 1951 : 118).

Besides the above opinions, the statisticians have already worked out to solve the problems of statistical analysis of small samples and, techniques have been developed which give fairly high degree of precision. Considering the techniques for small samples in this research work, the formulae used are in accordance with the statistic of small samples like adjust standard deviation, students 't' test distribution, proportional *chi-square* test, analysis of variance. Further, the priciple of degree of freedom for each statistical analysis has been strictly followed. In some archaeological works (Misra, 1967) the present researcher found that sample size was small i. e. less than 50, but no adjustment was made in the formulae like standard deviation, students 't' test distribution and even the principle of degree of freedom has not been followed strictly. Because of these two factors the interpretations made by scholars on the basis of statistical analysis can be interpreted in the other way after appropriate adjustments in the formulae used and by following the principle of degree of freedom. However, the formulae used for small samples is applicable for large samples but can not be *vice-versa.*

The assemblage size sampled at different sites in the present study is relatively small. Even then, the validity of the statistical results can not be ruled out in the light of the facts that the samples were collected on the basis of probability sampling procedure and the principles of statistics were strictly followed.

APPENDIX B

FLINT-KNAPPING EXPERIMENTS

A number of scholars like Burkitt (1963), Sankalia (1964), Crabtree (1967b, 1972), Crabtree and Gould (1970), Bhattacharya (1972, 1979), Oakley (1975) have summarised most of the flint-knapping techniques and, needless to repeat here. Moreover, authors such as Crabtree and Butler (1964), Rinehart (1964, 1966), Cotterell (1968, 1970, 1972), Faulkner (1972), Speth (1972, 1974) and Cotterell and Kamminga (n. d.) also tried to study the mechanics of stone fracture. All these and other studies suggested that how different types cf stone flakes, blades and tools like handaxe, chopper/chopping, scraper, burin, point, triangle, lunate, trapeze, micro-burin, etc., would have been made.

Possible causes of variability among assemblages belonging to similar tradition include cultural, stylistic, functional, temporal or sampling error. Besides these, scholars also argued about the variability caused by raw material in the archaeological assemblages collected from different sites (Crabtree, 1967a; Clark; 1980; Straus, 1980). It has been noticed by authors that a change in fabricator or mode (cf. Newcomer, 1975) also make a change in the shape and size of flakes/flake scars (Crabtree, 1967b, 1972; Newcomer, 1971, 1975). It is also observed that similar flakes/flake scars can be produced by different fabricators and to know about a fabricator requires a number of experiments on the same raw material by different fabricators (Newcomer, 1975).

In the light of above observations and suggestions a series of experiments were carried out by the author. Here, an attempt has been made by the author to replicate a few stone artifacts of Lower Palaeolithic period. The purpose of replication is to demonstrate the role of raw material and fabricator in the study of lithic technology and assemblage variability. The artifacts replicated are handaxes, cleavers, knives, scrapers, spheroids and flakes (Plates XXXIII, XXXIV). Raw materials used for the experiments include sandstone, quartzite, chert, lime stone and flint, and fabricators involved in the direct percussion technique comprise of stone hammer, light-stone hammer with rounded ends and antler.

Big flakes were removed from the boulders or cobbles either by block-on-block technique or by direct stone hammer percussion technique. The

selection of technique based upon the size of the primary form of raw materials. Thereafter, flakes of required dimensions were removed by stone hammer through direct percussion technique.

Handaxes and knives were made on flakes and were bifacially retouched either by stone hammer or rounded light stone hammer and/or antler (Plates XXXIV : 1, 2, 3 ; XXXVI : 1). During replication of handaxes and knives a number of flakes of various dimensions (debitage) came out including typical biface trimming flakes (Plate XXXIV : 4).

Cleavers were made by flake-cleaver technique using stone hammer or rounded light stone hammer and/or antler. Flake-cleavers were obtained by the intersection of the distal portion of the previous flake scars and the primary flake surface. The former surface was used for the dorsal distal face of the flake-cleaver (Sinha, 1984 ; Plate XXXV). In the course of bifacial retouching of the lateral sides and butt end a number of flakes of various dimensions (debitage) including typical biface trimming flakes came out (Plate XXXIV : 4).

Scrapers and spheroids were made on flakes or chunks by stone hammer or rounded light stone hammer and/or antler (Plate XXXIII : 1, 3, 5). During the process of unifacial retouching flakes came out though, a few in numbers in comparision to flakes came out in the manufacturing of handaxes, cleavers and knives and no typical biface trimming flake was present among these small flakes (debitage).

The following observations have been made in the course of experiments regarding raw materials, fabricators and debitage :

1. Flakes/flake scars produced by stone hammer (Plate XXXVI : 2) to some extent are distinguishable from those produced by rounded light stone hammer and antler (Plate XXXVI : 3, 4).

2. Flakes/flake scars produced by rounded light stone hammer and antler are hardly possible to distinguish and, requires a series of experiments and/or observation under microscope for micro-wear traces (Plate XXXVI : 3, 4 ; Sinha, 1985).

3. It is very difficult to remove regular and uniform flakes on coarser raw material such as sandstone.

4. It is very hard to make fine and thin artifacts on coarser raw materials and distal end of some tools like point, picks, etc. This is probably because of big grain sizes of such raw materials and low flexibility and often get break in the process of finner retouching.

5. Generally, flakes or flake scars on lime stone have relatively more prominent positive or negative bulb of percussion than those on other raw material used in this research (compare Plate XXXVI : 1-4 and Plates XXXIII, XXXIV : 1-4).

In the light of above observations the following conclusions can be made.

1. The raw material is relatively more important element than the fabricator in the study of lithic technology.

2. Crude or fine appearence of tools does not merely depend upon the workmanship rather also on the type of raw material used for manufacturing artifacts. One more explanation is also possible in Binford's terminology (1973) that crude tools may generally have been "expedient" tools, whereas many of the fine tools may have been "curated" tools. However, this explanation needs further systematic explorations and experiments.

3. It may be possible that an assemblage fashioned on coarser raw material consists of a low frequency of tools like pick, point, etc.

4. A detail study of raw material, debitage and flake scars on tools and cores should be made before claiming about the probable flint-knapping technique of an assemblage.

5. It would not be proper to assign the assemblage earlier or later merely by making technological comparision with other assemblages fashioned on different raw material.

To sum up it may be said that while making assemblage comparision the analyst should keep in mind the above mentioned facts which may lead him towards a proper, systematic and scientific conclusions.

DESCRIPTION OF ILLUSTRATED EXPERIMENTAL ARTIFACTS

Plate XXXIII *Flint-Knapping experiments.*

1. **Spheroid, sandstone, hammer : stone.**
2. **End and Side scraper, sandstone, hammer : antler.**
3. **Rounded scraper, sandstone, hammer : stone.**

4. Quadrilateral flake-cleaver, sandstone, hammer : rounded light stone.
5. Single side scraper, sandstone, hammer : stone.
6. Unmodified flake, sandstone, hammer : stone.

Plate XXXIV *Flint-Knapping experiments.*

1. Triangular handaxe, sandstone, hammer : antler.
2. Side knife, sandstone, hammer : rounded light stone.
3. Ovate handaxe, limestone, hammer : antler.
4. Rest are small flakes (debitage) came out in process of final retouching, also include biface trimming flakes, above the scale of sandstone and below the scale are of lime stone.

Plate XXXV *Flint-knapping experiments.*

1. Detached primary form of flake-cleaver (flake) on core, sandstone, hammer : stone.

Plate XXXVI *Flint-knapping experiments.*

1. Ovate handaxe, lime stone, hammer : antler.
2. Group of flakes, lime stone, hammer : stone, bulbar aspect.
3. Group of flakes, lime stone, hammer : rounded stone hammer, bulbar aspect.
4. Group of flakes, lime stone, hammer : antler, bulbar aspect.

Plate XXXIII. Flint-Knapping experiments.

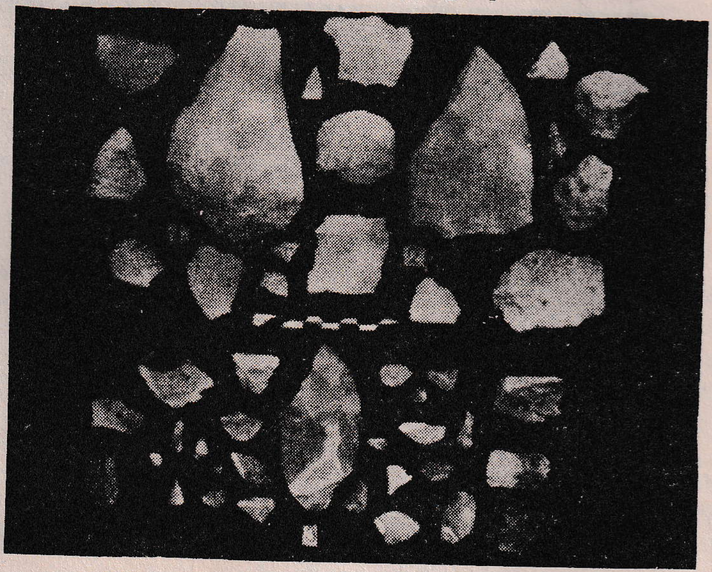

Plate XXXIV. Flint-Knapping experiments.

Plate XXXV. Flint-Knapping experiments.

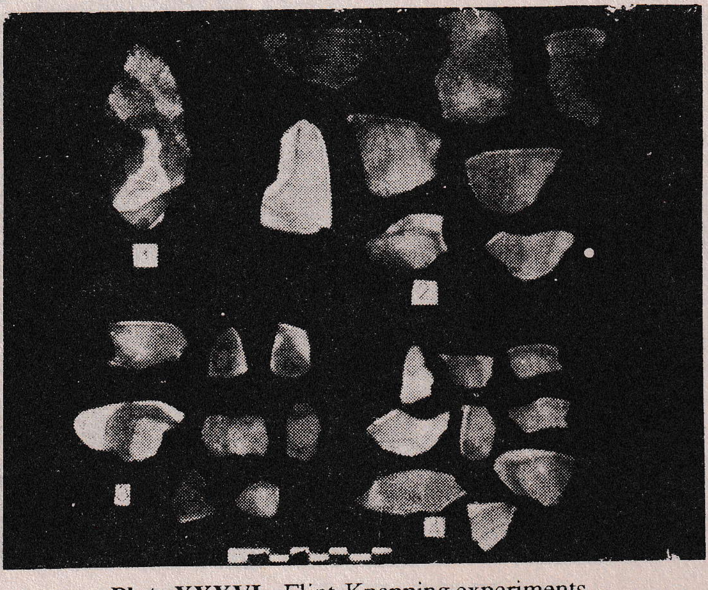

Plate XXXVI. Flint-Knapping experiments.

APPENDIX C

SUGGESTIONS

Indian archaeological researches are passing through a transitional phase between the traditional or old fashioned approach and systematic and scientific explanation and evaluation of data to solve old and new archaeological problems. The archaeological field work for the last few decades, indeed, provided valuable material in maping the prehistoric and protohistoric India and, contributed considerably in solving problems of different dimensions. But, in changing archaeological perspective and introduction of new methods and techniques in archaeology some serious objections have been raised against the earlier interpretations and conclusions. Nevertheless, earlier researches, however, laid the foundation of reconstructing the history of prehistoric population. Thus, we have to modify and adopt different methodological and rational research tools.

The traditional methods and techniques of the archaeological field work have deen critically reviewed by some scholars. They, however, hardly placed any concrete suggestion how to rectify the traditional field methods. Recently, serious attempts have been made to remove short comings of the traditional approaches. Their major thrust is on the planning a national grid programme (Agrawal, et. al. 1983) and on the criteria and area that should be explored (Paddayya, 1978).

We believe that if the probability sampling procedure is applied in the scheme of field work as proposed by Paddayya, then it would provide more unbiased primary data regarding activities of the prehistoric population in whole of the study region (sample/target population) and not merely from in and around the river valleys.

Generally, it has been noticed that the research scholars whose dissertations are based on regional survey for the award of D. Phil/Ph. D. degree have had to face several serious problems in want of proper assistance from their institutions for the field work. Some of the problems usually encountered by the researcher are non-availability of local transportation, man power (labour), lodging and fooding. Money is the key to most of the similar problems. One way to minimise such difficulties may be if the institution takes up the job to provide adequate financial and technical support. But, due to

financial and other constrains of institutions/departments it is hardly possible. More advantageous and practical suggestion, therefore, would be to assign one region to three or more research scholars on different archaeological problems/periods. Inter-disciplinary approach has become a necessity in solving various archaeological problems. It would be, therefore, more useful if the students of the interelated discipline work together, following a inter-disciplinary approach in the region. Such a team work, besides sharing financial and and technical burdens may contribute a lot in order to broaden our perspectives and knowledge regarding the palaeo-environment, and the behaviour and activities of prehistoric populations in the region.

The archaeology of the settlement pattern has been introduced recently in Indian archaeology. Therefore, the term and the methods and techniques involved yet to be properly understood (Sinha, n. d. d) It is basically an extensive field oriented research. Some scholars, however, treated it simply as an armed chair archaeology.

The process of the settlement pattern in the region, during a cultural period, is a multidimensional phenomenon. There are a number of factors, directly or indirectly, responsible for the distribution of the settlements in the region. The crux of the archaeology of the settlement pattern is to know them. The records of the past explorations are, usually, devoid of informations and controlled data necessary to know the settlement pattern in the region. Perhaps, the aims and goals of the earlier explorers were different and they can hardly provide relevant information through their memory lane. Moreover, some technical features become clear only in the field. Hence, a revisit to the sites and the region and, collection of cultural material through controlled sampling procedures are the bindings on those who are engaged to know the settlement pattern in the region, explored a long back or by others. Binford rightly said "When new question arise, methods must be altered to allow for their solution". Otherwise such research work, I believe, will be as simple as 'to put the old wine (inadequate, unscientific data) in the new bottle (settlement pattern)'.

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Index

Author Index

Subject Index

About the Author

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